DEC 7 1942

AUTOMOTIVE and Aviation INDUSTRIES

DECEMBER 1, 1942

Breakfast at Ten

AT NIGHT

● When most people are turning out lights for the night, breakfast is cooking in homes of thousands of New Departure men and women. Three shifts of ball bearing makers rearrange their lives to speed up production essential to the victory of our arms. Win? Of course we will win.

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● Responding to today's demand for near-perfection, New Departure research engineers are gaining new engineering knowledge about bearing design and application for the benefit of all mankind when Peace returns.

MEN AND WOMEN OF

New Departure

THE FORGED STEEL BEARING

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NEW STANICUT OILS

PARTICULARLY DEVELOPED FOR YOUR WAR-TIME MACHINING PROBLEMS

● IN THE first plants to retool for war production the need for more efficient cutting fluids was soon apparent. To produce parts in the quantities needed and still meet the rigid specifications for accuracy and finish was a problem which cutting oils could help solve.

So, working with these first plants, Standard Oil Engineers developed and tested oils and coolants on many types of jobs. Now, with *many* plants performing the same operations, these newly developed oils are made available to *all* in the new series of STANICUT OILS.

A brief description of three of these oils and the jobs they are doing are outlined below.

STANICUT OILS ARE HELPING TO DO THESE WAR JOBS

FUSE ADAPTERS FOR 37MM. SHELL

Stanicut 62 FC was developed primarily for machining tough aluminum alloys. It gives considerably better tool life and finish than kerosene and lard oil blends commonly used. The higher flash point of this Stanicut Oil reduces the fire hazard.

On an automatic operation, machining aluminum 17 ST for fuse adapters, parts are cut off, drilled, counterbored, formed, drilled, and chamfered at the rate of one each 10 or 12 seconds. Even at this high speed parts and oil run cooler with Stanicut 62. Finish and tool life are good; and reduced carryaway on parts and chips has cut oil consumption one-third.

SLOTTING ENGINE COOLING FINS

Stanicut 107 BC is designed for high speed automatic work on free cutting steels. It is also suitable as a coolant where carbide alloy tools are used, and can be used on high speed machining on copper and brass, without danger of staining the work. Stanicut 107 sometimes works well on harder steels, too, as shown by this unusual case history:

Stanicut 107 BC increased tool life 75% in slotting cooling fins of airplane engine cylinders from 1050 steel tubing. Tool consisted of 18 bits per tool head, spaced $\frac{1}{8}$ in. apart. Width of bit 3/16 in. Depth of cut $\frac{7}{8}$ in. Feed .002 in. per revolution. Stanicut 107 kept work cool and saved considerable shut-down for tool grinding.

MACHINING NOSE OF 20MM. A. P. SHOT

Stanicut 309 BCS is especially designed for machining soft steels or those which tend to tear easily and make it difficult to get good finish. It may be blended with paraffine oil for less severe conditions. It will, under some conditions, work very well on harder steels, as shown by this case history:

In forming the nose of 20 mm. armor piercing shot from 4150 steel, Stanicut 309 eliminated a grinding operation for finishing. Machining was done on a hand screw machine operating at 485 rpm. Depth of cut approximately .02 in. per revolution with hand feed.

IF YOU HAVE ANY SPECIAL CUTTING OIL PROBLEMS

or if you are just retooling for war work and find it difficult to get the necessary accuracy, finish and tool life on converted machines, call in a Standard Oil cutting oil specialist. See if one of these new oils—and the Engineer's experience in applying them—can help you. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you.

STANDARD OIL COMPANY (INDIANA

AUTOMOTIVE and Aviation INDUSTRIES

Published Semi-Monthly
Volume 87 December 1, 1942 Number 11

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Cable Address ..... Autoland, Philadelphia

Member of the Audit Bureau of Circulations
Member Associated Business Papers, Inc.

AUTOMOTIVE and AVIATION INDUSTRIES is a consolidation of the Automobile (monthly) and the Motor Review (weekly), May, 1902; Dealer and Repairman (monthly), October, 1903; the Automobile Magazine (monthly), July, 1907, and the Horseless Age (weekly), founded in 1895, May, 1918.

Owned and Published by
CHILTON COMPANY
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Executive Offices
Chestnut and 56th Streets, Philadelphia, Pa., U. S. A.

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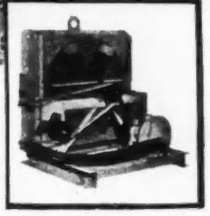

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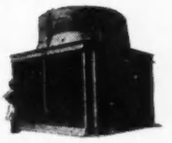
For one large aircraft engine manufacturer, dissipating the heat from dynamometers on test runs of production engines was causing excessive water costs; not to mention frequent repair and overhaul due to hard scale deposits in the dynamometer jackets. YOUNG Engine Jacket water coolers were installed, resulting in savings of $1.84 on water costs alone per engine test run. Using a closed system with YOUNG units doing the cooling makes it possible to treat the Jacket liquid with YOUNG inhibitor insuring maximum efficiency and performance at all times. Constant temperature regulation of the jacket water is provided, thereby eliminating thermal distortion caused by excessive jacket water temperature changes due to variations in operation. Whatever your heat transfer problem may be, YOUNG products include a unit to handle it—equipment for heating and ventilating, cooling units for gas, gasoline and diesel engines, and equipment for aviation.



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GEAR-CUTTING JOB
They Prefer Texaco
★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.
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★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.
★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.
FALK GEARS...the largest shown has 287 teeth, 1½" diametric pitch, 32½" face. Weight finished, approximately 39,375 lbs. There are no machining jobs too large . . . or too small . . . for Texaco Sulfex Cutting and Soluble Oils.

LONG HOB-LIFE is a "must" on work like this. To avoid backlash, once started, the hobber must not stop!

Big cast steel gears like these require 24 hours or more to complete and hobs *must* stay sharp.

Texaco Sultex Cutting Oils keep them sharp and are preferred everywhere for difficult machining jobs.

Texaco Cutting Oil lubricates the hob and keeps down the heat, preventing chip welding and assuring better surface finish.

Increase output per tool grind, reduce idle machine time, save hard-to-replace cutters by using Texaco.

The outstanding performance that has made Texaco preferred in the fields listed in the panel has made it preferred by prominent users in the metal-cutting field.

Texaco users enjoy many benefits that can also be yours. A Texaco Engineer specializing in cutting coolants will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distributing points in the 48 States, or write The Texas Company, 135 East 42nd Street, New York, N. Y.

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TEXACO Cutting and Soluble Oils
FOR THE METAL-WORKING INDUSTRY

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

IN THIS ISSUE . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 87 December 1, 1942 Number 11

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

Tire Requisitioning In England

The British Ministry of Supply is taking a census of laid-up cars and light trucks and their tires, with the object of finding out where they are stored, so that they can be requisitioned without delay when necessary for essential war requirements. Although it may be desired to requisition a small proportion of these unused cars in the near future, the chief result of the census, it is admitted, will be the requisitioning of the tires almost at once. Some sizes are wanted as replacements for vehicles on war work, but the majority will be taken so that the rubber can be reclaimed for other war purposes. It is estimated that about 10,000 tons of reclaimed rubber will be secured in this way.

Before being requisitioned, every tire will be valued to assess the compensation to be paid to the owner, who will have the option of appealing if he is dissatisfied with the official valuation.

The tires will be removed by "experts" appointed by the Ministry; they will probably be employees of the 1500 officially appointed tire depots that alone have been allowed to deal in tires since the sale of tires, new and reconditioned, was brought under control early this year.

Make Every Pay Day

"BOND DAY"

Get back of the Pay-Roll Savings Plan by encouraging employees to turn part of their earnings *regularly* into tanks and planes and guns through systematic purchase of

U. S. WAR BONDS

Ford War Plant Facilitates Straight-Line Production 18

This plant is outstanding not only for its contributions of metallurgical research leading to a simplification of foundry and forging practice, but for its production equipment and methods. This account of what is being done puts the spotlight on several features of procedure not generally known. Turn now to page 18.

Fuels and Lubricants Discussed at Tulsa 31

New things are stepping into the foreground daily from the ranks of fuels and lubrication products. The SAE National Fuels and Lubricants Meeting stripped them down to the chassis and gave them a thorough going over. This report will bring you right up to date on the subject.

The Ramsey Plant at Fruitport 34

Getting a plant ready in a rush, for the rush needs of a war program and then have it dominate its position with efficient methods in production, is the background of this account. No one who desires to keep abreast of the times should neglect to read it.

Short Cuts 38

A few issues back there appeared some short cuts—short items with illustrations showing how the other fellow is doing it better, quicker or cheaper. It proved so popular that this issue has four pages more of them. Be sure to look them over. There may be a money or time saver that you can adopt.

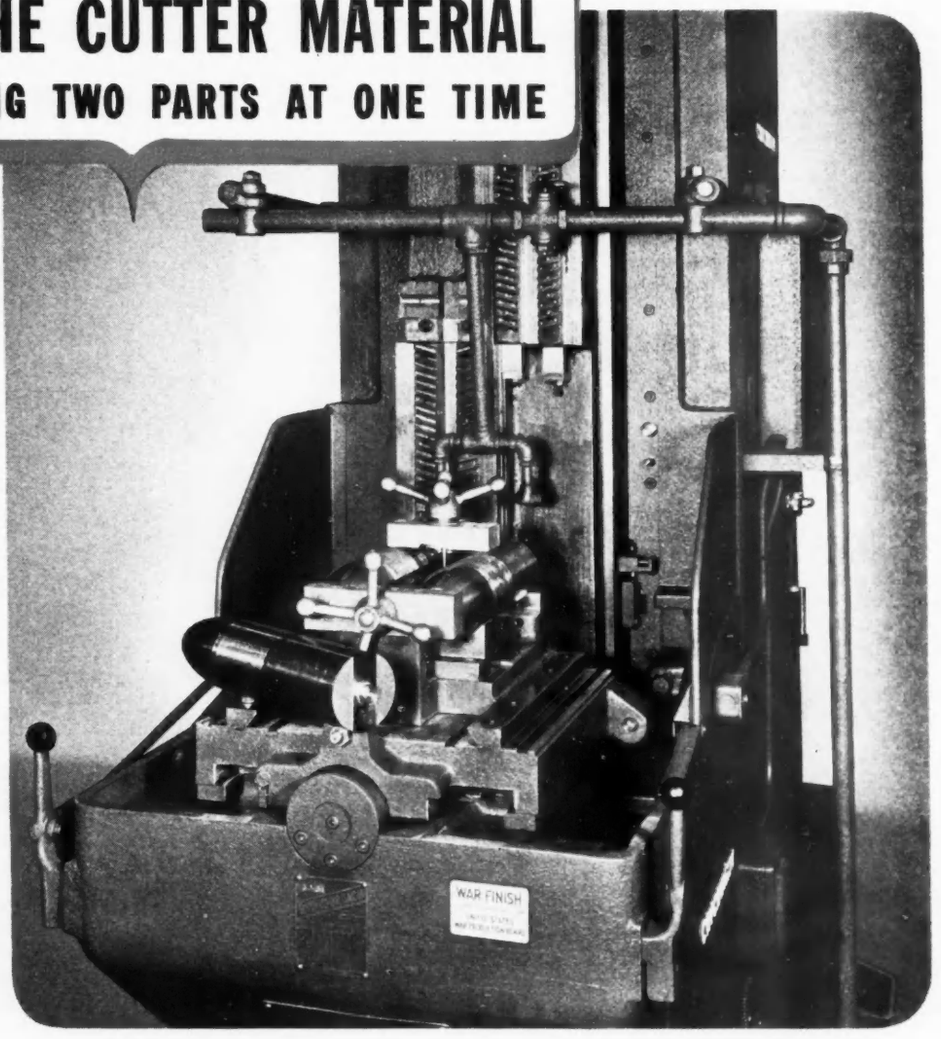
New Rotol Propeller 46

This new type propeller offers advantages not before available for trainer planes. With it, students can get practical experience on two-engined craft in the effect of feathering that was not possible in previous models.

This Idea

SAVED 1/2 THE CUTTER MATERIAL

WHILE BROACHING TWO PARTS AT ONE TIME



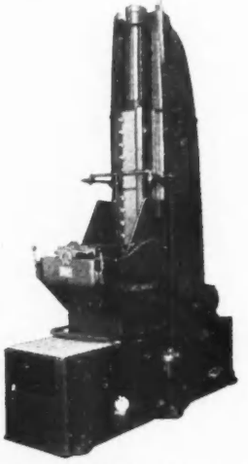
CINCINNATI

AT first glance, the commonplace surface finishing operation on the rear end of these mortar shells offers little opportunity for exercising ingenuity in method, production, or tooling. Two flat surfaces are required, and they could be machined in several ways. However, the method selected by the CINCINNATI Engineering Service Department offers these important war-time savings:

In production: two parts broached at one time. **In equipment:** a space-saving CINCINNATI No. 10-54 Single Ram Hydro-Broach. **In critical cutter material:** only one-half the usual length of broaching inserts.

Ordinarily, one thinks of a single ram machine as broaching one part at a time. Nevertheless, the table of this machine is large enough for two parts, so the fixture and broach holders were arranged accordingly. Each tooth of the broaching insert was designed to carry the maximum safe load, with the result that the cutting tools are much shorter than usual saving about 1/2 the high speed steel.

Perhaps many parts in your shop could be surface finished more economically on CINCINNATI Hydro-Broach Machines. Our Engineering Service Department will be glad to make recommendations based upon your requirements.



● CINCINNATI Single Ram Vertical Hydro-Broach Machine. Complete specifications may be had by writing for catalog M-886

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

Vol. 87, No. 11
December 1, 1942

Automotive Production Methods Cut Manpower Requirements

FIVE thousand workers are unemployed in the Detroit area. Yet in the same city a former automobile body company making bomber subassemblies received a single applicant from a 21-inch illustrated help wanted advertisement which ran for three days in one of the daily newspapers. That is one of the anomalies of the labor situation in the Arsenal of Democracy as the War Manpower Commission attempts to chart the course of employment in the coming months.

Changes in strategic consideration such as the newly opened campaign in North Africa are responsible for changes in emphasis upon various weapons and these are reflected in employment totals. Raw materials like steel and copper also are limiting factors and their lack may curtail operations in some plants as these materials are channeled into factories producing weapons that are more vitally needed at the moment. Military truck output has been tapered off of late, with the manufacturers concentrating on replacement parts rather than final assemblies in order that trucks already in the field may be kept in service. This shift has caused reduction in working hours up to 40 per cent in one plant. Manufacture of tanks and guns likewise has been cut to permit concentration on other items.

Aircraft, shipbuilding and ammunition are receiving increasing emphasis. Airplane procurement has been put at the top of the priority list by President Roosevelt and the revised 1943 goal of 100,000 warplanes will be expedited by the four-man WPB aircraft board headed by Charles E. Wilson, president of General Electric Co. Ammunition needs have been revised upwards now that the U. S. is in a shooting war on the African continent as well as having the Pacific fleet engaging the Japanese in the Solomon Islands.

Thus it is that a truck plant in the Detroit area may have some of its employes idle while an aricraft plant next door may be working three shifts and have the "help wanted" sign out seeking more workers to expand production. One Detroit manufacturer of aircraft wings and subassemblies will need 6,000 workers in the next three months to meet advancing production schedules. Where will these additional workers come from? Women offer one answer, especially in aircraft plants where the light assemblies are easily handled by feminine labor. A registration of women in four counties comprising the Detroit area last August brought replies from 180,000 women who indicated willingness to work in war plants and of that number 53,000 said they had previous factory experience.

Increasing employment of Negro labor also is helping alleviate the manpower shortage in Detroit. In the 164 largest plants in this area, total employment increased 18 per cent in the five months from June through October. In those same plants for the same period, Negro employment advanced 55 per cent. Negroes, who comprise 8 per cent of the total population in the metropolitan Detroit area, now make up 6 per cent of the factory employment in that area. Emphasis of fair labor and non-discriminatory practices by the federal government has helped bring about this change. There has been some friction in plants that formerly did not employ Negro labor but no trouble has been encountered in companies that have made a practice of hiring Negro workers.

By E. L. Warner, Jr.

Changing emphasis on various war products at the expense of others is responsible for the fact that labor demand in the automotive industry has not been as great as anticipated. The expected production rate of $22 million worth of armaments daily from the automotive industry by Jan. 1, 1943, probably will not be attained due to this realignment of schedules, according to George Romney, managing director of the Automotive Council for War Production. Current factory employment in the Detroit area is estimated at 677,000, which is 31 per cent greater than the 1941 peak month. The projected total for February, 1943, as made some months ago by the U. S. Employment Service was 734,000 workers, an increase of 57,000. Peak employment figure for 1943 as estimated by the USES was 778,000, 101,000 more than the present level and probably to be reached in September.

However, some experienced labor observers in the automotive industry believe this peak estimate is much too high. They figure that 30,000 to 40,000 additional

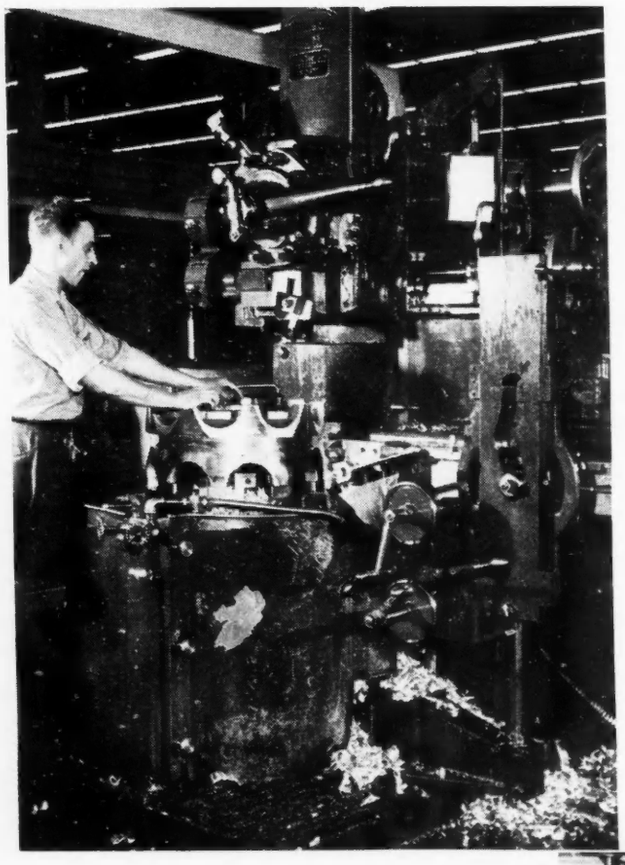
(*Turn to page 78, please*)

Ford War

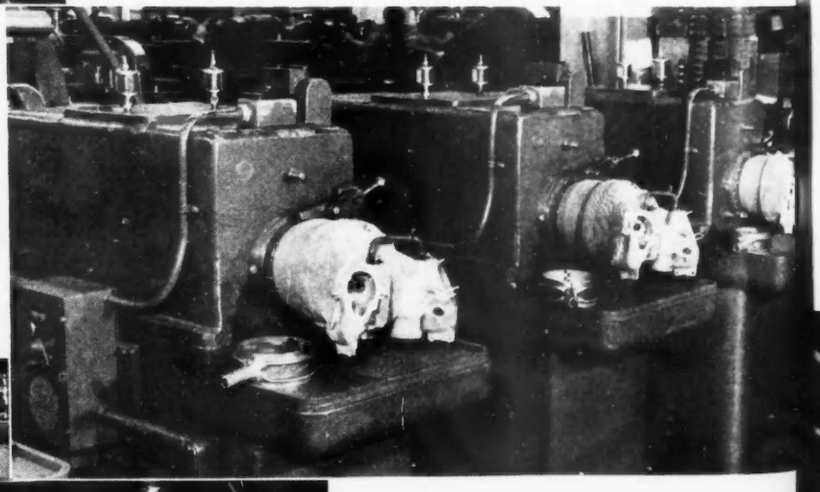
CONSIDERED to be one of the finest examples of aircraft engine manufacturing undertaken by the automotive industry, the plant operated by the Ford Motor Co., is distinctive not only for its production equipment and methods but also for the many contributions of metallurgical research leading to a simplification of foundry and forging practice as well as a tangible reduction in the use of critical materials.

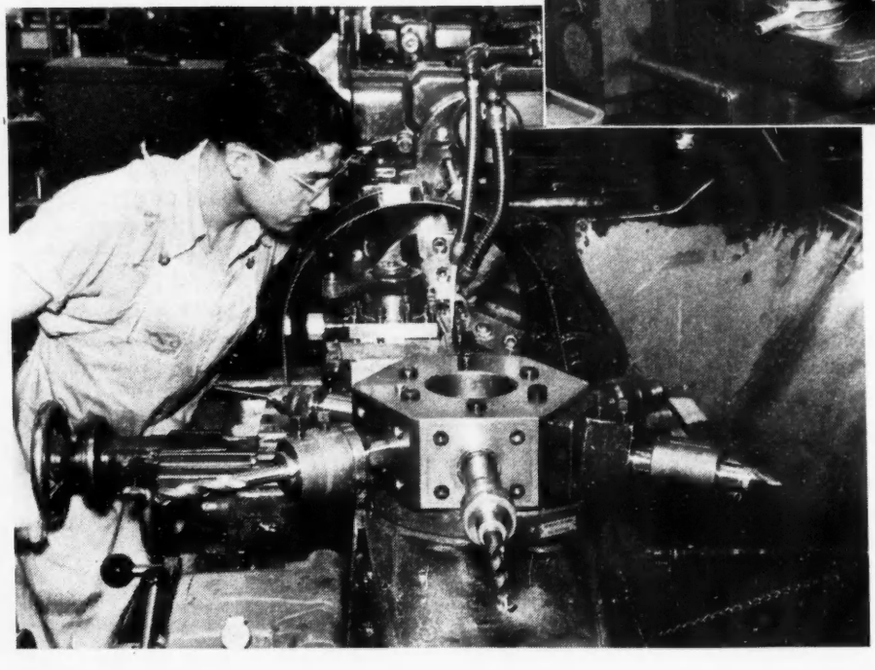
Ford is building Pratt & Whitney's double-row, radial air-cooled engine of the latest design. This operation is unique in the extent to which it it completely self-contained—self-contained as to the manufacture of all of the major elements of the engine; self-contained as to the production of castings and forgings—both of ferrous and non-ferrous types.

The aircraft engine building, one of the largest in



(Above) One of a battery of Bullard V-T-L's in the crankcase department. This one is turning, boring, grooving and facing the center section.





(Above) Part of a battery of Barnes Drill Co., special honing machines in the engine assembly department. They are employed for the break-in of piston and ring assemblies with a selected cylinder.

(Left) Close-up of one of the Gisholt turret lathes in the gear department.

Plant Facilitates Straight-Line Production

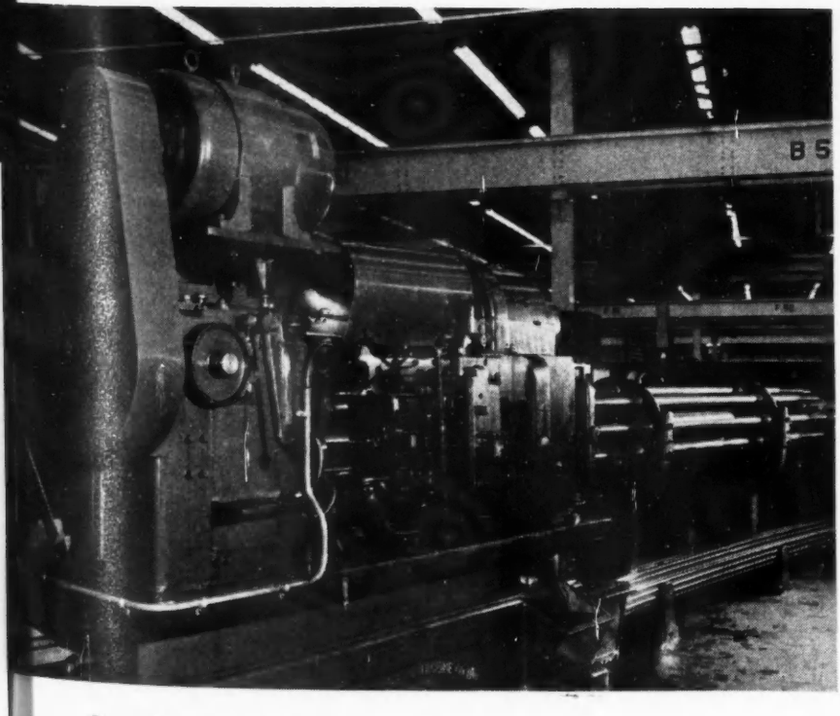
By Joseph Geschelin

the industry, exemplifies the best practice of industrial design developed by Albert Kahn and his associates. It is a beautiful modern structure, developed specifically for the purpose, laid out to facilitate straight-line production, comfortably cooled in summer to provide the best working conditions. Worker comfort and quality control are further assured by the installation of the most advanced artificial lighting system of continuous fluorescent tube fixtures extending in rows clear across the full width of the ceilings. From the standpoint of production machinery, this plant has equipment of quite the same character as will be found in similar establishments. Nevertheless, as a result of accumulated experience, methods have been progressively changed and improved so as to increase productivity and to raise the level of quality. Faced with the growing need for expanding engine output, Ford is making arrangements to farm out certain detail operations on many of the component parts. This work will be done in other Ford plants, primarily in the Ford Village Industries group.

This is the Seventy-sixth in the series of monthly production features

Materials handling, an unfailing symbol of mass production, has been developed skillfully to facilitate a smooth flow of raw materials and parts. This is expressed in the form of monorail conveyor systems of various kinds, special bench type belt conveyors, etc. In addition, a great deal of heavy carting is done with the aid of the versatile Ferguson-Ford tractors.

Not evident to the casual observer are the many fine details concerned with metal cutting practices. For example, cemented-carbide-tipped tools are employed on the majority of operations on steel and on practically all turning, boring, and facing operations on non-ferrous metals. The role of cutting fluids has been given special attention, the needs of every individual operation having been studied carefully and suitably taken care of. This will be evident from the comments noted elsewhere in this article. The industrial diamond is widely used throughout the machine shops, being found principally in the dressing tools



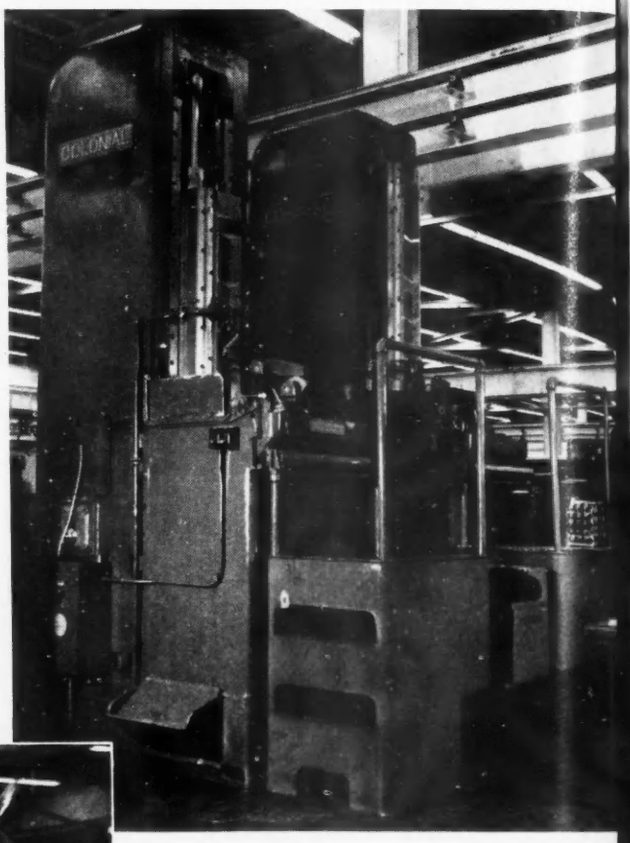
Largest of the machines in the P & W engine department are the huge 8-spindle Conomatics, used in producing screw machine parts of various kinds.

on internal and external grinders, on spline grinders, on angular grinders, on thread grinders, on gear grinders, etc. Without these dressing tools it would be impossible to maintain the precision required of these specialized machines.

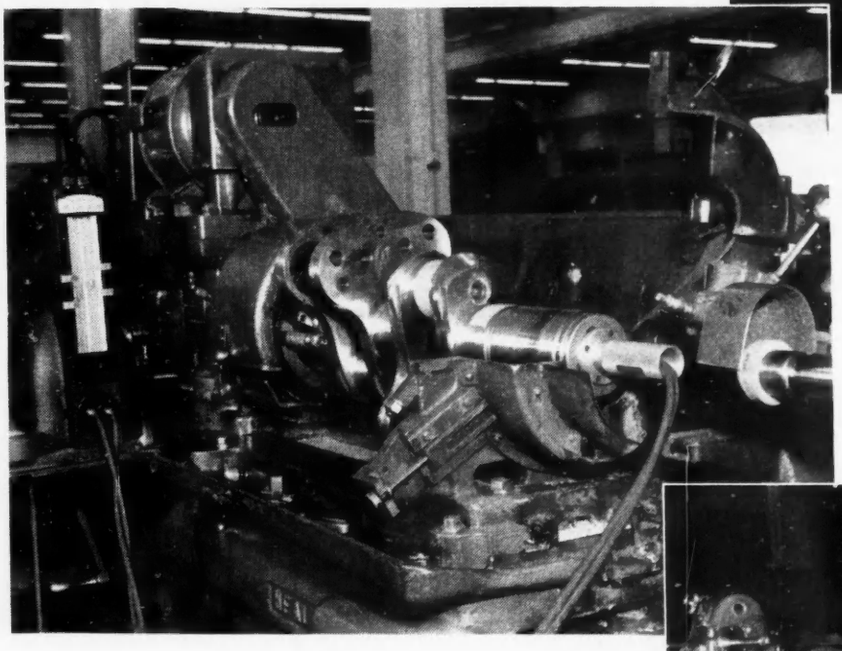
Due to the multiplicity of detail operations on the many major parts of the engine, our object is to provide a sketchy perspective of the overall picture, touching only briefly on some of the highlights, and relying upon a pictorial sampling in some of the departments. At the time this article was written, Ford had begun producing its own pistons. The piston department is self-contained, features a large battery of Sundstrand Model B automatic lathes, Cincinnati milling machines, Heald Bore-Matics, Norton grinders and other items of equipment.

Another of the small departments is devoted to the production of knuckle pins for the connecting rod assembly. Here is a battery of large Conomatics for turning the blanks from bar stock; Gisholt turret lathes for turning, facing, and boring operations; Cincinnati centerless grinders for finishing the O.D. The internal bore is honed on Micromatic Microhoners.

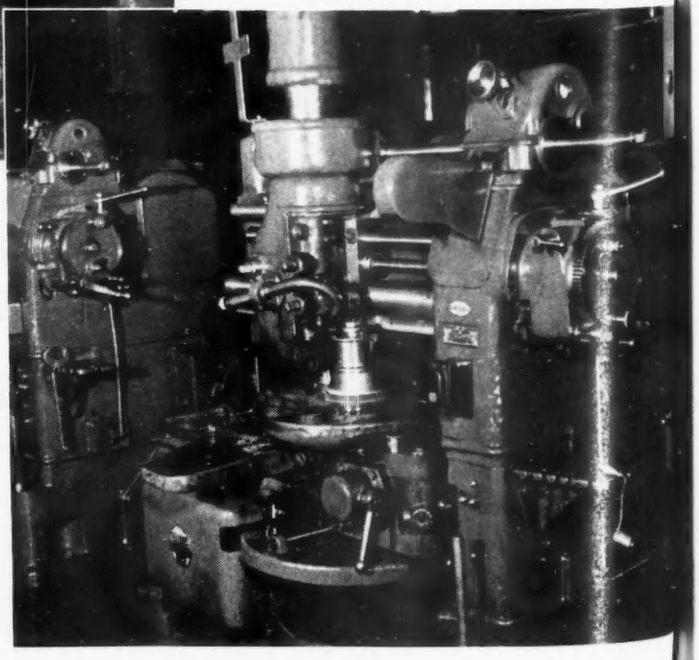
Cam rings are handled from the rough forgings. The



(Above) Towering Colonial surface broaching machines tooled up for roughing the sides of connecting rods.



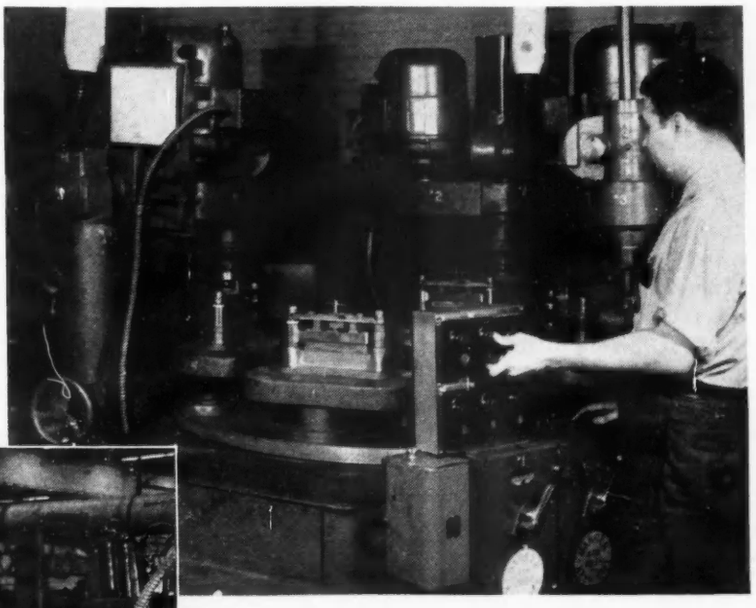
(Above) Here is an interesting set-up on a Heald internal grinder. This is the operation of boring the clearance hole through the crank assembly. Note the Sheffield Precisionnaire gage, mounted permanently at the extreme left-hand end of the grinder, this view showing its use in exploring the ground bore.

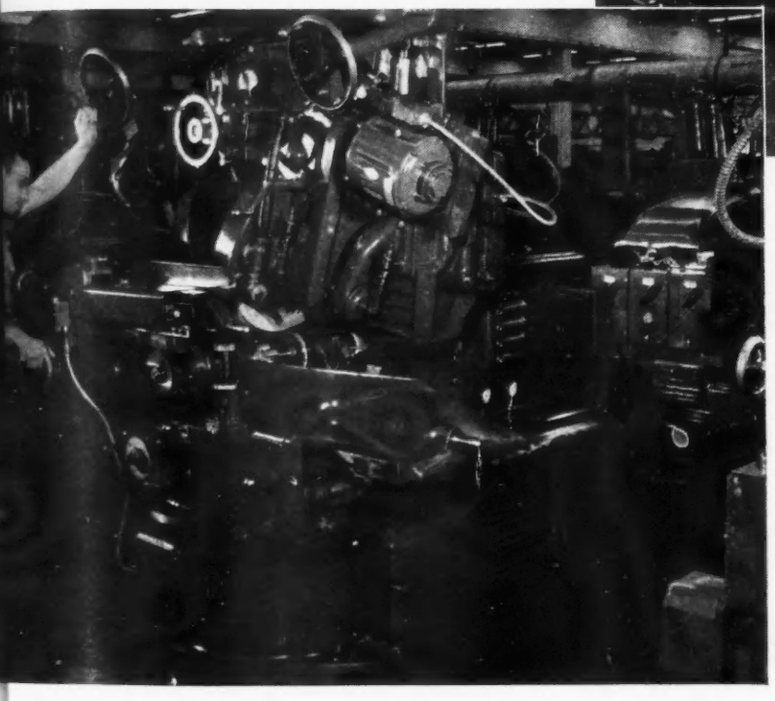


(Right) Close-up of one of a large battery of Fellows gear shapers installed in the gear department.

(Right) Special Acme Mfg. Co., polishing machine with multiple heads designed for the automatic polishing of all side faces of link rods.

(Below) Example of the two-wheel, high production Pratt & Whitney precision gear ginder in the engine gear department.





first operation, rough turning, is done in Fay automatic lathes, fitted with cemented-carbide tools; in all, three operations are done on Fay automatics. Cam contour is milled on Van Norman contour milling machines which are fitted with huge master cams for both exhaust and intake cam systems, controlling the action of twin heads. Cam contour is ground to perfection on Landis hydraulic cam grinders. The internal gear teeth are cut on Fellows gear shapers, finish-lapped on Fellows lappers. External gear teeth are cut on Fellows gear shapers, finish-ground on the new Geargrind grinders. Internal and external cylindrical surfaces are ground on Heald machines. After machining, the cams are polished all over, by hand, then subjected to Magnaflux inspection and to detail inspection for dimensional accuracy.

As may be expected, large areas are set aside for the fabrication of master rods and link rods. In the interest of space economy, only the highlights of the link rod line will be considered here. First operation, roughing of bosses and sides, is done on a battery of two towering Colonial surface broaching machines in which each side is finished in one pass of a wide broaching tool. Then follow some detail operations on Kearney & Trecker mills; and the drilling of end holes on Barnes Hydram single-spindle drilling machines. The other two sides are broached on smaller Colonial vertical surface broaching machines.

Boss ends of the link rods are contoured on Fellows gear shapers. The rod channel is formed directly from the flat surfaces, previously prepared by broaching, on a battery of four-spindle Cincinnati Hydro-Tel machines, taking four rods at a time, with eight rods in the big fixture. The rods then are loaded into a Despatch oven and held at a moderate temperature for about an hour to relieve the stresses imposed by the roughing operations, in preparation for finish grinding.

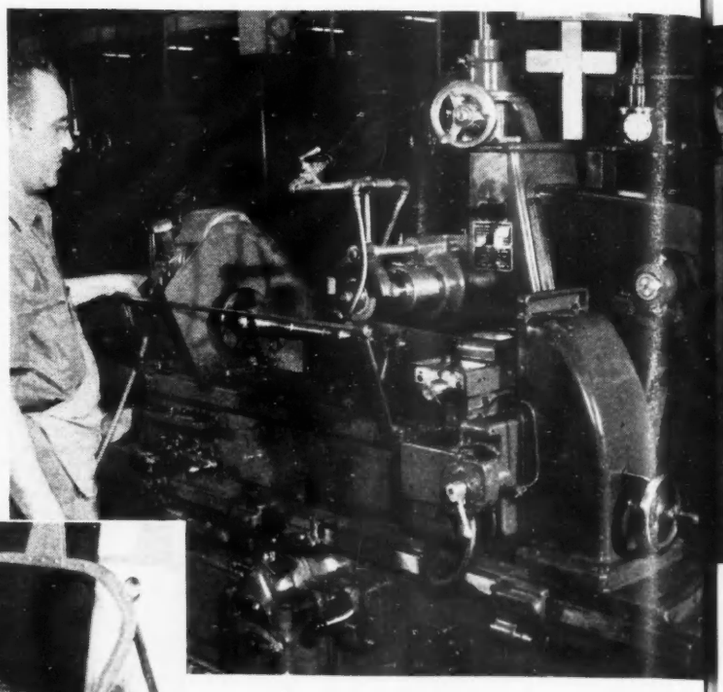
Flat surfaces are finish-ground on Norton surface grinders; end bores are ground on Bryant internal grinders. These bores are finished by honing in Barnes honing machines fitted with Micromatic hones. Following this, bronze bushings are pressed into the honed bores, and are finished by precision-boring in Heald machines fitted with cemented-carbide fly-cutters.

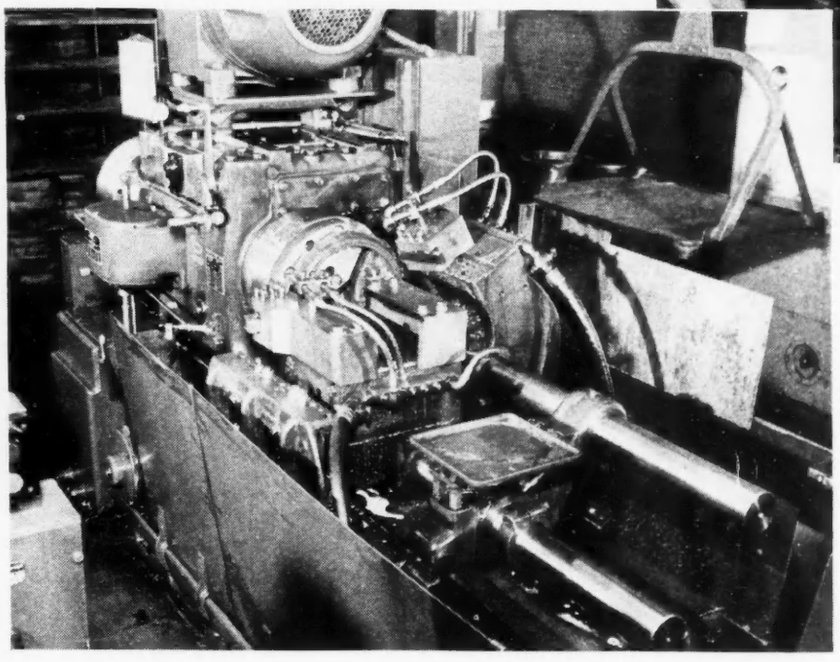
Distinctive touch of Ford methods is the development of a special automatic polishing machine supplied by the Acme Mfg. Co., for polishing the entire contour of the sides and boss ends of the link rod. This is a three-head machine with a fourth station for loading and unloading. The rod is mounted in a fixture on a cam-operated plate which completes its entire cycle of movement while presenting the work area to the polishing wheels at each station.

Impressive example of progressive development through advanced metallurgical techniques is found in the case of the cylinder barrel assembly. This consists of two separate sections—the aluminum muff which is essentially the finned section, and the cylinder barrel which becomes a relatively simple sleeve.

First machining operation on the muff is rough turning and boring on a battery of Bullard Mult-Au-Matics. Final operations are performed on a battery of Fay automatic lathes, the most impressive stage being that of finning. This is done with 78 cutting tools, arranged in three tool slides, each one containing 26 tools. The fins are exceptionally deep, beautifully finished, and held accurately as to depth and spacing.

The alloy steel cylinder barrel is centrifugally-cast, a distinctive Ford development, producing a saving of melted metal as compared with the conventional method of forging. Moreover, the rough casting weighs about ten pounds less than a similar drop-forged piece, eliminating that much metal from the chip removal operations.





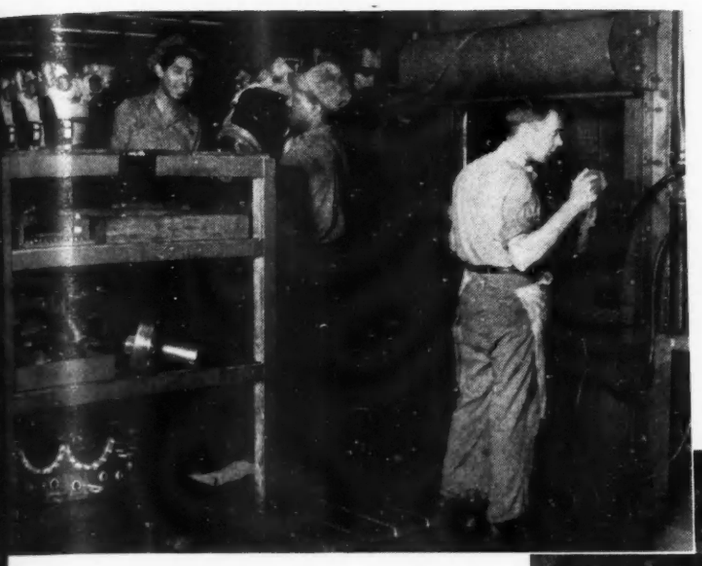
(Above) One of the new Geargrind precision grinding machines used by Ford for grinding gears, and splines as shown here.

(Left) Fay automatic lathe—roughing the cam forging. Note particularly the massive tool holders and heavy single-point cutting tools.

(Below) This unusual machine is a specially-designed Sundstrand boring machine, arranged with two boring heads for boring, facing and chamfering the cylinder bores and pads.

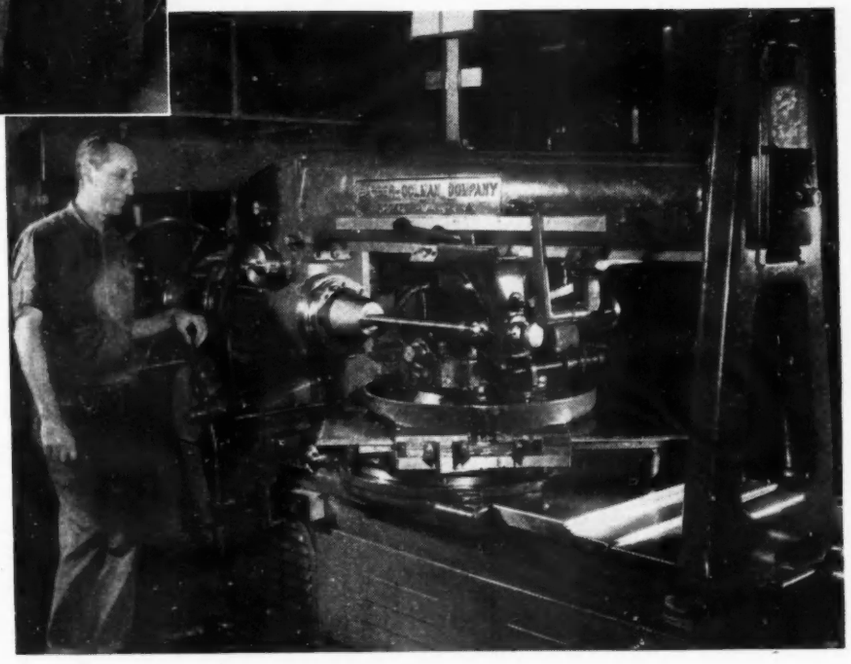
The cylinder barrel is rough-machined on Bullard Mult-Au-Matics in another plant and comes into the engine plant ready for finishing operations. External cylindrical surfaces are finished on a large battery of Norton grinders of cylindrical and angular head types, the latter being employed for finishing shoulders, flanges, and for the formation of radii. One of the interesting operations in this connection is the use of a two-wheel Norton grinder on the O.D. Internal bores are rough- and finish-ground on Bryant 16-C-16 internal grinders.

Outstanding of the grinding



(Left) View at tear down station in the assembly department. After the green run all engines are torn down, the component parts placed on these racks, and all parts thoroughly washed in a large Detrex kerosene washer adjacent to the spray station at the right.

(Below) Heavy duty Barber-Colman gear hobber in the gear department, used for cutting gears, splines, and serrations.



operations on the barrel is the cylindrical grinding of the muff diameter. Consider that this is now an extremely thin-walled section and that it must be finished to fine tolerances without distortion or mis-alignment. This problem has been solved by the development of a patented water-cooled arbor, flooded internally with a stream of coolant held under positive pressure of one pound per sq. in. This device, coupled with the flood of sulphurized soluable compound on the wheel, keeps the work and wheel cool, prevents distortion. Incidentally, the grinding finish is held to six to eight micro-inches (rms).

External threads on the barrel are cut on the Ex-Cell-O precision thread grinder.

The power section for this engine is composed of three major elements—front section, rear section, and center section, the latter being split into two halves on the diameter to facilitate assembly. The center section takes about 31 major operations, the front section about 19, the rear section about 22 and the complete assembly about 66 operations, for a total of 138 major operations.

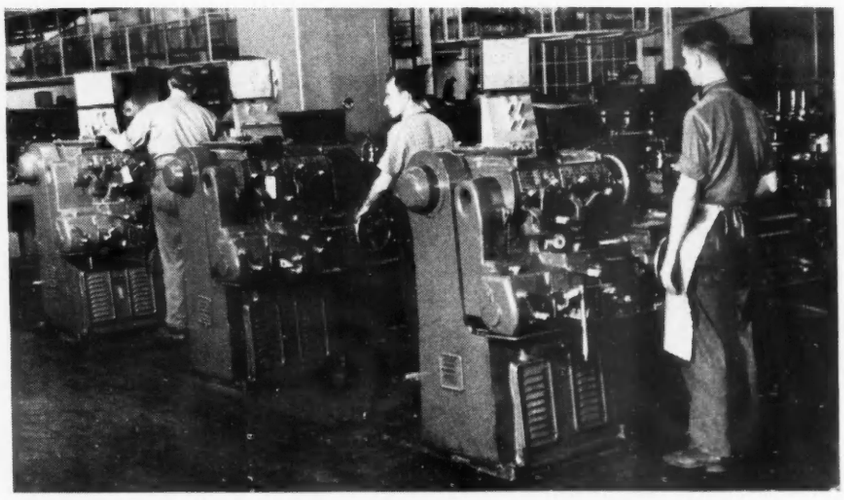
Major part of the production equipment for the power section consists of a large battery of Bullard V-T-L's, set up in each of the departments. The center section is rough turned and bored in its initial cylindrical form on a V-T-L, then split on a major diameter on a sawing machine. The parting face then is milled on a Cincinnati mill, using milling cutters tipped with cemented-tungsten-carbide. Following various drilling operations, the two halves are bolted together, rough-turned on the O.D. and grooved, on a V-T-L. Meanwhile, the front and center sections go through corresponding stages in adjacent departments and at this point the three major sections are bolted together and have the cylinder bores rough-bored on a special Ex-Cell-O boring machine.

Due to the intermingling of operations on all three sections during machining, Ford employs a system of locator holes and dowels to assure accurate alignment of each matched set. At one stage, the entire power section assembly is bolted together, turned and line-bored on a V-T-L. An interesting piece of equipment developed for this line is a special two-head Sundstrand machine for boring, facing, and chamfering the cylinder bores. This machine has an indexing fixture for progressively indexing each of the nine pads.

The case is fitted with bearings which are pressed-in with a shrink fit, the bearings being prepared for this operation by chilling in liquid air.

The cylinder head is machined in a self-contained department, first operation being done on a Warner & Swasey turret lathe in which the rough forging is centered. In all there are about 45 operations on the head, the major work being done on Bullard Mult-Au-Matics in which the head is completely domed.

Consider now the highlights of assembly operations for the cylinder and head assembly. First stage is the shrinkage of the muff onto the cylinder barrel. For



Here is part of a sizable battery of sturdy Monarch lathes, fitted with double-compound tool blocks.

this purpose, the muff is heated in a Gehnrich oven at a high temperature, then simply pressed onto the barrel. Then comes the assembly of the cylinder head. The head is heated in an oven for two hours at a high temperature. Immediately upon removal of the head from the oven, various small inserts previously chilled to a low temperature in a Deep-Freeze cabinet are pressed into place and driven home. Then the head is screwed onto the barrel.

Following this, the assembly proceeds through the final machining operations, such as drilling of flange bolt holes in alignment with valve guide holes. This particular operation is done in Barnesdril drill presses. The valve seats are precision-ground on a battery of Hall eccentric valve seat grinders, fitted with electrical pressure control.

The assembly is masked, sand-blasted, coated with an aluminum spray in Metallizing booths, washed in a Detroit Rex degreasing machine. Then it goes to the paint spray booths, of Industrial Sheet Metal design, for the various coats of special enamel. This coating is dried by passing through a tunnel type baking oven fitted with infra-red lamps having gold plated reflectors. The trip through the tunnel ovens is made with the work suspended on a monorail conveyor.

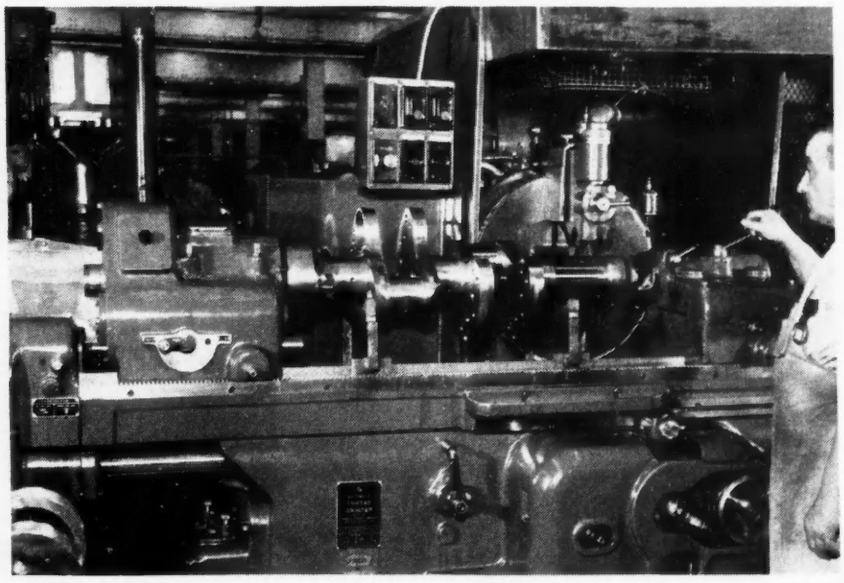
The plant is self-contained with respect to gear production, makes 62 different gears, for a majority of the gears in each engine. Gear practice follows essentially the pattern of the techniques recommended by the aircraft engine builder whose engine is made here, although many innovations and short cuts have been introduced as a result of actual production experience.

Generally speaking, Fellows gear shapers are employed for cutting step and shoulder gearing, for internal gears and splines, and for tapered serrations. Barber-Colman gear hobbers are extensively employed in cutting external spur gears and worms. Gleason gear generators are used for cutting bevel gears. Fellows gear lappers are used for lapping internal gears. All external gears are ground, the department being generously endowed with various types and makes of gear grinders, including Pratt & Whitney single and double-wheel machines, Fitchburg grinders, and the new Geargrinders. After grinding, all gears are lapped in Fellows machines. Gleason quenching machines are used in the heat treating department to assure freedom from fire distortion. Ex-Cell-O precision thread grinders handle all threading operations including small internal threads.

The gear department is served by a large screw machine department for turning blanks from forgings or bars. Here will be found 6- and 8-spindle Bullard Mult-Au-Matics, Gisholt bar lathes, Warner & Swasey turret lathes. It is of interest to note that all gear turning operations are done with cemented-carbide-tipped tooling.

One example of gear practice is the machining of the impeller shaft. A battery of Monarch lathes with double-compound attachments is used for various turning operations. Internal splines are produced by broach-

(*Turn to page* 102, *please*)



J. & L. automatic thread grinder in the crankshaft department. Shown here, it is cutting the thread on one end of the shaft.

Stinson-built L-5 Sentinel for U. S. Army liaison work.

Stinson Planes for War Service

Two new warplanes—the L-5 for U. S. Army liaison service and the AT-19, a navigation trainer for British naval pilots—are in production at the Wayne, Mich., plant of the Stinson Division of Vultee Aircraft. The L-5 has been named the Sentinel and the AT-19 the Reliant.

The L-5 Sentinel is powered by a Lycoming 190 hp horizontally opposed engine, has a wing span of 34 ft, length of 24 ft and a gross weight of 2100 lb. It is a highly maneuverable plane designed to be the "eyes upstairs" of the artillery, tank corps, cavalry, and infantry. Carrying a pilot, observer and complete radio equipment for communication with all types of ground units as well as with other planes, it can hover and maintain altitude at a speed of less than 45 mph.

The fuselage is made of welded steel tubing, the wings and tail surfaces of wood. To conserve vitally-needed materials, the plane was redesigned just before it was put into production to make use of wood and other non-critical materials wherever practicable. This eliminated almost 20 per cent of the steel and almost 70 per cent of the aluminum in the original design.

To absorb landing shocks on rough terrain, the stroke of the spring-and-oil shock absorbers has been lengthened to approximately double that of conventional types. The plane is equipped with flaps and slots to increase its inherent stability and to make possible its unusual performance in take-off, landing, and steep climbing.

The AT-19 is being built under the direction of the U. S. Army Air Forces, but for assignment to the British Government under the lend-lease agreement. The new ship is essentially the peacetime Stinson Reliant now dressed in war paint. It has a seating capacity for four. The cabin of the peacetime model has been replaced by a military interior and fitted out with a multiplicity of specialized instruments used in teaching navigation. Pilots operating from carriers must fly long distances over the open sea without benefit of radio beams as a navigational guide and this ship is equipped as an advanced trainer for teaching that technique to pilots of the Royal Navy.

The plane is powered with a Lycoming 290 hp radial engine and is equipped with a constant speed propeller. Performance details are not given. Wing span of the plane is 42 ft, length 30 ft and gross weight 4000 lb.

This Stinson AT-19 will be used for teaching aerial navigation to British Navy flyers.

Part Two

Part One appeared in the November 15, 1942, issue of AUTOMOTIVE *and* AVIATION INDUSTRIES

Two-Stroke Diesel With

THE following calculations are to show that the amount of gas which flows through the preliminary exhaust into the turbine is entirely sufficient to perform the work of compressing the scavenging air and air-charge. For simplification of the calculation we neglect the leakage losses at the shaft and piston rings and the pressure losses in the pipes. We consider an engine with a cylinder content which corresponds to the charging with 1 kg of air. We assume that scavenging and charging of the cylinder take place without loss of air ($\phi = 1$).

We also assume that the weight of the fuel which is introduced into the cylinder is 0.04 times the weight of air.

Then the weight of the combustion products G_e = 1.04 kg. The pressure at the beginning of exhaust has been determined to be 5-6 atmospheres for high-speed two-stroke engines, while the temperature is 1100-1200 deg. *K*. In the case under consideration we calculate with $p_e = 5$ atmospheres and $T_e = 1100$ deg. absolute. If we assume a pressure at the turbine inlet of p_r = 1.5 atmospheres, then the corresponding gas temperature at the turbine inlet is determined from

$$T_r = T_e \left(\frac{p_r}{p_e}\right)^{\frac{n-1}{n}}$$

in which n is the exponent of the expansion, which one can assume to be 1.33. Therefore:

$$T_r = 1100 \left(\frac{1.5}{5}\right)^{0.248} = 815 \text{ deg. } K.$$

We assume that the volume of the gases before the exhaust opens is $V_e = 0.78H$, with the corresponding level of the exhaust port of $h_b = 0.22H$, and the volume of the gases before the scavenging port opens is $V_r = 0.9H$, at corresponding level of the scavenging port of $h_n = 0.1H$.

Before the exhaust opens the equation of state is:

$$p_e V_e = G_e R T_e \qquad (1)$$

and, at the moment of scavenging opening:

$$p_r V_r = G_r R T_r \qquad (2)$$

By division we obtain

$$\frac{p_e V_e}{p_r V_r} = \frac{G_e R T_e}{G_r R T_r}$$

from which

$$\frac{G_e}{G_r} = \frac{p_e V_e T_r}{p_r V_r T_e}$$

By inserting into the equation for the ratio of the weights, the quantities assumed above, we obtain:

$$\frac{G_e}{G_r} = \frac{5 \times 0.78 \times 815}{1.5 \times 0.9 \times 1100} = 2.15.$$

By making G_e equal to unity we get

$$G_r = \frac{G_e}{2.15} = \frac{1}{2.15} \approx 0.45.$$

That means that 45 per cent by weight of the combustion products must escape through the openings of the top row into the open, while 55 per cent are passed through the ports of the middle row to the turbine.

The necessary compression work for the adiabatic compression of G_L kg of air (corresponding to the assumed cylinder volume) from pressure p_o to pressure p_s can, taking into account the supercharger efficiency, be determined from the equation:

$$L_L = \frac{G_L T_o c_p'}{\eta_L} \times \frac{\left[\left(\frac{p_s}{p_o}\right)^{\frac{x-1}{x}} - 1\right]}{A} \qquad (3)$$

In this:

η_L is the adiabatic supercharger efficiency
c_p' is the specific heat of the air at constant pressure, (approx. = 0.242)
T_o is the temperature of the surrounding air
p_s is the outlet pressure of the scavenging air compressor
p_o is the pressure of the outside air
x is the adiabatic exponent = 1.41

To ensure that the cylinder will be properly filled it is necessary that the exhaust gases, whose internal energy is utilized in the turbine, should develop work

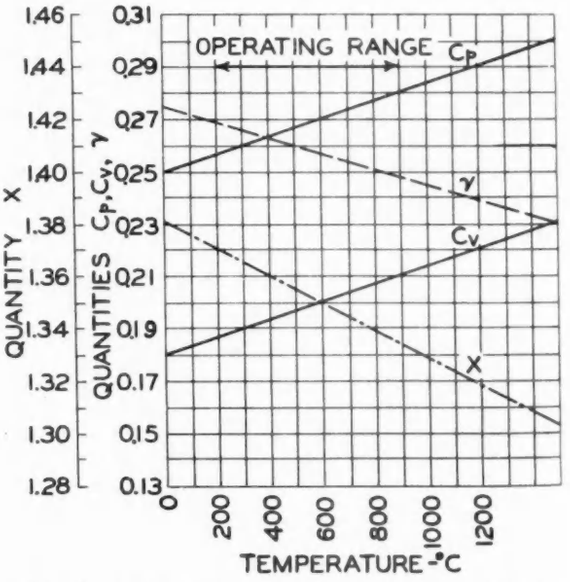


***Fig. 5—Constants for Diesel exhaust gases (after* Rateau)**

c_p = specific heat at constant pressure;
c_v = specific heat at constant volume

$$x = \frac{c_p}{c_v}; \gamma = \frac{x-1}{x}$$

By J. W. Swisstunoff and A. A. Kuritz*

Exhaust Turbo-supercharger

corresponding to (3). In this the turbine efficiency must be taken into consideration.

The effective work of the gases as they expand in the turbine from the pressure p_r to the pressure p_o is expressed by the equation:

$$L_T = \eta_T G_r c_p \frac{T_r\left[1-\left(\frac{p_o}{p_r}\right)^{\frac{n_1-1}{n_1}}\right]}{A} \qquad (4)$$

In this:

η_T is the adiabatic turbine efficiency
G_r is the weight of the exhaust gases
c_p is the specific heat of the exhaust gases, at p = constant, about 0.265 (Fig. 5)
n_1 is the exponent of the polytropic expansion for the gases in the turbine, = 1.35.

If one designates the mechanical efficiency of the turbo-charger by η_m, we have $\eta_m L_T = L_L$, i.e., the work of the turbine is at every moment to the work of the compressor:

$$\eta_m \eta_T G_r c_p \frac{T_r\left[1-\left(\frac{p_o}{p_r}\right)^{\frac{n_1-1}{n_1}}\right]}{A} = \frac{G_L c_p' T_o\left[\left(\frac{p_s}{p_o}\right)^{\frac{x-1}{x}}-1\right]}{\eta_L A}.$$

In this the overall efficiency of the unit is

$$\eta_a = \eta_m \eta_T \eta_L = \frac{G_L c_p' T_o\left[\left(\frac{p_s}{p_o}\right)^{\frac{x-1}{x}}-1\right]}{G_r c_p T_r\left[1-\left(\frac{P_o}{P_r}\right)^{\frac{n_1-1}{n_1}}\right]} \qquad (5)$$

For our case:

G_L = 1 kg (corresponding to the assumed cylinder volume),
G_r = 1.04 × 0.55 = 0.57 kg,
T_r = 815 deg. K, p_r = 1.5 atmospheres.

Quantities already assumed above:

C_p' = 0.242, c_p = 0.265, p_o = 1 atmosphere
x = 1.41, n_1 = 1.35

We assume T_o = 290 deg. *K* and, for good charging, a scavenging-air pressure p_s = 1.3 atmospheres.

These quantities introduced in (5) give, with a scavenging-air excess coefficient $\psi = 1$,

$$\eta_a = \frac{1 \times 0.242 \times 290\left[\left(\frac{1.3}{1}\right)^{\frac{1.41-1}{1.41}}-1\right]}{0.57 \times 0.265 \times 815\left[1-\left(\frac{1}{1.5}\right)^{\frac{1.35-1}{1.35}}\right]} = 0.455.$$

at $\psi = 1.2/\eta_a' = \psi\eta_a = 1.2 \times 0.455 = 0.545$.

One can easily obtain an efficiency of similar order of magnitude for the turbo-supercharger aggregate.

At present the efficiency of the Brown-Boveri turbo aggregate amounts to 55-60 per cent on the average. If the two-stroke engine with variable timing diagram is realized, we can regulate at will the pressure p_o at the beginning of exhaust, and consequently also the pressure p_r at the inlet to the turbine.

The assumed coefficient $\psi = 1.2$ and the scavenging-air pressure p_s = 1.3 atmospheres with changeable time-intervals and direct-flow scavenging, absolutely assure a good scavenging and sufficient charging for all engine speeds. (The Petters firm uses $\psi = 1.1$ in its direct-flow scavenged engines.) In most two-stroke engines the scavenging-air pumps are designed for a coefficient $\psi = 1.4$-1.5. With this is to be covered the scavenging-air expenditure which occurs at low speeds on account of escape through the open exhaust ports. At high speeds not so much air is needed, and the supply is reduced by throttling the intake.

We will now investigate how the scavenging-air pressure p_s will change with the pressure p_o at the beginning of exhaust. From (5) we have:

$$\left[\left(\frac{p_s}{p_o}\right)^{\frac{x-1}{x}}-1\right] = \eta_a \times \frac{G_r c_p}{G_L c_p' T_o} \times T_r\left[1-\left(\frac{p_o}{p_r}\right)^{\frac{n_1-1}{n_1}}\right]$$

If we insert:

$$p_o = 1;\quad \frac{x-1}{x} = \frac{1.41-1}{1.41} = 0.29$$

$$\frac{n_1-1}{n_1} = \frac{1.35-1}{1.35} = 0.26$$

and if we also introduce a constant factor:

$$\eta_a \times \frac{G_r c_p}{G_L c_p' T_o} = A,$$

then we obtain:

$$p_s^{0.29} - 1 = A T_r\left[1-\left(\frac{1}{p_r}\right)^{0.26}\right]$$

Transformed:

$$p_s^{0.29} = A\left[T_r - \frac{T_r}{p_r^{0.26}}\right] + 1.$$

We set:

$$T_r - \frac{T_r}{p_r^{0.26}} = \tau$$

and find:

$$p_s = (A\tau + 1)^{\frac{1}{0.29}} = (A\tau + 1)^{3.44} \qquad (6)$$

For simplification we assume that the overall efficiency of the aggregate, with $\psi = 1.2$, remains constant and equal to 0.5 during the change of p_e; besides the weight ratio (G_r/G_L) also remains constant, and equal to 0.57.

$$T_o = 290 \text{ deg. K}; \quad c_p = 0.265; \quad c_p' = 0.242$$

then:

$$A = 0.5 \times 0.57 \times \frac{0.265}{0.242 \times 290} = 0.001075.$$

On the basis of the equations of state (1) and (2), assuming constant the quantities G_e, G_r, V_e and V_r, the ratios (p_e/p_r) and (p_r/T_r), also remain constant.

We previously assumed that $p_e/p_r = 5/1.5$, hence

$$p_r = 0.3p_e \text{ und } \frac{p_r}{T_r} = \frac{1.5}{815}$$

and

$$T_r = 543.3p_r.$$

In this way one can, if p_e is given, find all the quantities necessary for insertion in (6) and therewith p_s.

The calculations are summarized in the following table and the results are plotted in Fig. 6.

p_e	$p_r = 0.3p_e$	$T_r = 543.3p_r$	$p_r^{0.26}$	$\frac{T_r}{p_r^{0.26}}$	$\tau = T_r - \frac{T_r}{p_r^{0.26}}$	$A\tau + 1$	$p_s = (A\tau+1)^{3.44}$
3.5	1.05	570	1.015	560	10	1.01075	1.03
4	1.2	650	1.05	620	30	1.0324	1.115
5	1.5	815	1.112	742	73	1.0785	1.275
6	1.8	977	1.162	833	144	1.155	1.635
7	2.1	1140	1.21	942	198	1.213	1.95

The curve in Fig. 6 shows that, in two-stroke engines, one can obtain any desired scavenging-air pressure with the help of the turbo-supercharger, by regulating the beginning of exhaust. The considerations which have been made up to this time correspond to the case in which the exhaust gases at the turbine inlet have a constant pressure during the working period.

In practice one can increase the energy of the gases entering the turbine beyond that corresponding to constant pressure. This is accomplished by using the pressure peaks of the gas flowing into the turbine, by suitably dividing and guiding the pipes (pipes of corresponding volume and cross-section go separately from each cylinder into the turbine; guide blades are located at points of strong deflection in the pipe, etc.). In practice the exhaust pressure of high speed two-stroke engines runs to 4-7 atmospheres and more. Assuming an air-excess coefficient $\alpha = 1.8$, it depends also on the speed. For machines with a mean speed of 500 r.p.m., the exhaust pressure reaches 7 atmospheres without disadvantage for the economy of the normal two-stroke engine.

As regards the ability to regulate the exhaust, this is completely utilized in the turbo-supercharger at 4-7 atmospheres, as also follows from the table. The method of working of the changing of the turbo-supercharger and the two-stroke engine is also indicated in this.

A two-stroke engine with ordinary scavenging and charging system (without exhaust control) cannot be used together with exhaust gas turbo-supercharger as the following calculation shows. With the values assumed earlier, $p_e = 5$ at. and $T_e = 1100$ deg. K, and if we assume that the pressure at the turbine inlet is $p_r = 1.2$ at., then the temperature at the turbine inlet becomes:

$$T_r = 1100\left(\frac{1.2}{5}\right)^{0.248} = 770 \text{ deg. } K.$$

in this $n = 1.33$; the other quantities are the same as formerly, $G_L = 1$ kg; $G_r = 1.04$ kg; $T_o = 290$ deg. K; $c_p = 0.265$; $c_p' = 0.242$; $n_1 = 1.35$, and $x = 1.41$; with this the scavenging of the engine is to be assured. In this case we assume the scavenging pressure at 1.3 atmospheres.

According to equation (5) we obtain, with an air expenditure coefficient $\psi = 1$.

$$\eta_a = \frac{1 \times 0.242 \times 290\left[\left(\frac{1.3}{1}\right)^{0.29} - 1\right]}{1.04 \times 0.265 \times 770\left[1 - \left(\frac{1}{1.2}\right)^{0.26}\right]} = 0.62$$

and with $\psi = 1.2/\eta_a' = \psi\,\eta_a = 1.2 \times 0.62 = 0.74$. The pressure drop $\triangle p = p_s - p_r = 0.1$ atmospheres which is quite insufficient, for a good cleaning of the cylinder of a high-speed machine requires, as one sees, such a high efficiency as 0.74. This is not yet reached at present with medium apparatus. Besides, the temperature reduction before the turbine, which results from the exhaust gas dilution by the scavenging air, is not yet taken into account.

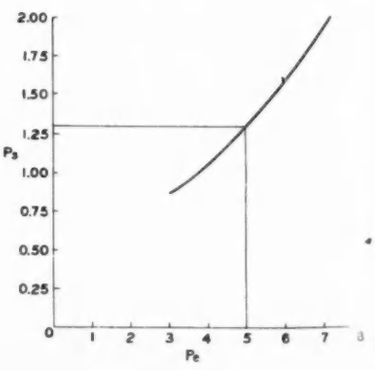


Fig. 6 — Dependence of scavenging pressure p_s on the pressure p_r at the beginning of exhaust.

Operating Diagram and Compression Volume Changed

In the above we have already pictured the impossibility of a fixed and the advantages of a changeable

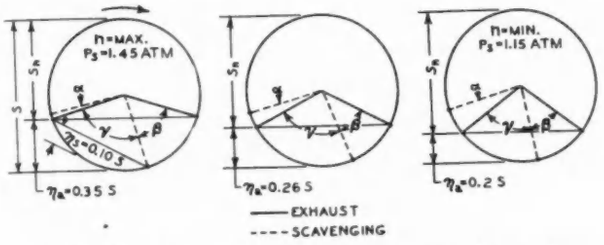


Fig. 7—Operating diagrams for a two-stroke engine with direct-flow scavenging and variable operating timing.

operating diagram. Venediger shows, in his paper (q) "Grundsatzliche Betrachtungen zum Zweitaktverfahren," that an operating diagram which satisfied the following requirements would be ideal:

1. The angle β of the exhaust up to the beginning of the scavenging must increase as the speed increases —introduction of the exhaust.
2. The filling angle α must decrease as the speed increases—charging.
3. With a reduction of the speed, the useful piston stroke S_n must increase.
4. Exhaust and scavenging angles β and γ must increase with the speed.
5. The possibility of changing the time-intervals of exhaust and scavenging in direct ratio to the speed (Fig. 7).

After investigating 10 possible variable-timing diagrams for two-stroke engines, Venediger came to the conclusion that, to satisfy the five conditions mentioned, intake and exhaust control by means of a rotary valve is necessary.

There are numerous patents on the regulation of exhaust and scavenging periods with rotary valves in engines which must operate through a wide speed range. But the difficulties involved in designing a rotary exhaust valve have so far prevented their application in practice.

Another possibility of regulating the exhaust period consists in changing the lift of the exhaust valve by means of a hydraulic plunger. This, however, requires complicated special plunger pumps, for which reason it has not been developed. The exhaust and operating diagram, which has been proposed and is shown in Fig. 7, completely satisfies four of the requirements and partly satisfies the fifth, which concerns the exhaust. The beginning of uncovering and the cut-off of the exhaust are shown by the full lines, while the dashed lines show the uncovering time of the scavenging ports. In Fig. 3 is shown a kinematic sketch of the exhaust-valve drive. This clearly shows the range of regulation of the exhaust period and of the corresponding compression ratio.

From Fig. 3 it can be seen that the stroke of the exhaust piston is $4e$ for an eccentricity e.

(q) ATZ, VI, 1936, No. 11.

Together with the port-opening period, the compression space is changed. Engines with variable compression space should find wide application in motor vehicles and tractors, where there is need for changing the tractive force during operation. The tractive force depends on the mean effective pressure, and, therefore, every automotive internal combustion engine must be able to operate at widely varying mean pressures. An increase of up to 50-60 per cent in the load should be possible without increasing the peak pressure. The use of a device for changing the compression ratio of the engine during operation would solve this problem.

The design of the slide-valve mechanism, Fig. 8, is based on the following calculation of bearing loads on the pins of the flexible drive. We assume a combustion pressure of 50 kg/cm² and a permissible specific pressure of 250 kg/cm² in the needle bearing of the knuckle joint. According to Fig. 9, we have

P is the maximum load of the exhaust piston, taken up by the knuckle joints A and B.

F is the reaction force, equal to the force P, taken up by the knuckle-joint D and by the crankpin of the operating shaft E.

Q is the reaction force, equal to $2P$, taken up by the knuckle-joint C.

With this:

$$P = p_z \frac{\pi d^2}{4} = 50 \frac{\pi 13^2}{4} = 6600 \text{ kg.}$$

$F = P = 6600$ kg; $Q = 2P = 2 \times 660 = 13{,}200$ kg. With this the magnitudes of the effective supporting surfaces for the pins A, B and D become

$$f = \frac{p}{k_{max}} = \frac{6600}{250} = 26.4 \text{ cm}^2.$$

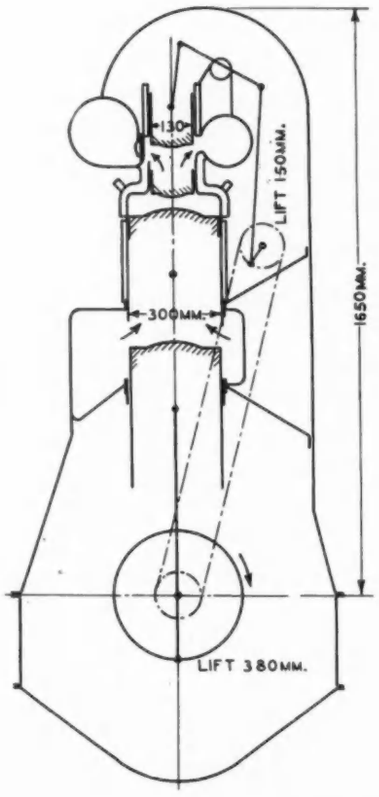


Fig. 8—Constructive possibility of the slide-valve arrangement.

One can assume an effective pin length of $l = 45$ mm. and a diameter $d = 60$ mm., so that the supporting surface $f = ld = 4.5 \times 6 = 27$ cm². The magnitude of the effective area of the pin C is: $f_c = 2f = 2 \times 26.4 = 52.8$ cm². With a pin diameter $d_e = 80$ mm. one can assume the length of the bearing surface at $l_e = 65$ mm. We assume a permissible pressure for the bearing pins of the operating shaft E of $K_{max} = 200$ kg/cm², and find the necessary size of the bearing surface:

$$f_E = \frac{F}{k_{max}} = \frac{6600}{200} = 33 \text{ cm}^2 = l_E d_E.$$

If we assume: $l_E = 0.5\ d_E$, then $f_E = 0.5\ d_E$, from which

$$d = \sqrt{\frac{f_E}{0.5}} = \sqrt{\frac{33}{0.5}} = \sim 8 \text{ cm}.$$

Therefore: $d_E = 80$ mm. and $l_E = 45$ mm.

In calculating the connecting rod for the exhaust piston, an engine of medium power was assumed. As the results show, one can, for small and great engines, construct exhaust slide-valve drives of compact design and harmonic form.

The regulation of the exhaust is particularly important in the development of a two-stroke engine which is scavenged without a supercharger. The investigations of Professor Davies* have shown that, with correct choice of uncovering or cut-off of the exhaust or scavenging ports, sufficient fresh charge gets into the cylinder in the engine directly behind the escaping exhaust gases. When the exhaust port is uncovered, the gases flow out, at the enormous velocity of about 800 meters per sec. in the first thousandth of a sec., and thus leave behind a vacuum. They then impinge on gases which are at rest in the exhaust pipe (from the preceding cycle) and produce in front of them a pressure of up to 2 atmospheres, and move in one front to the open end of the pipe. If there is a pressure in front of the gases and a vacuum behind them, the exhaust gases from the cylinder finally reverse their direction of flow.

Davies concludes that the flowing off of the exhaust gases does not follow the well-known efflux law, but proceeds ballistically. If this is so, it is conceivable that the calculation methods which are used for exhaust ports (involving equations depending on the critical velocity at efflux), which do not take into consideration the pressure fluctuations in the exhaust of the engine, give too large dimensions for the ports. With ports so dimensioned, a part of the exhaust gases flows back into the cylinder before the exhaust is cut off, and dilutes the charge.

(*) "Engineering," No. 3727-37-38. Reference in "Dieselestrojenije" No. 12, 1937.

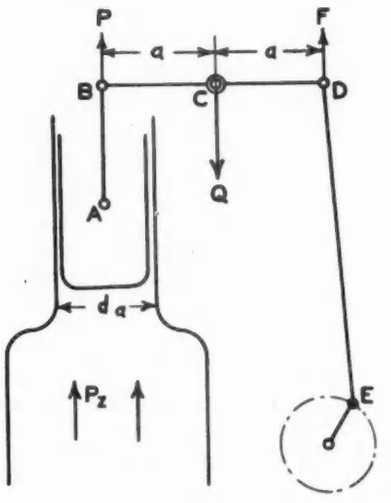


Fig. 9 — Force plan for the drive of a piston slide-valve.

Experience has shown that when a two-stroke engine is supercharged, scavenging is better; for the amount of exhaust gas is greater than with a normal charge. In order to prevent the return of the gases into the cylinder when the engine works at different speeds, the exhaust cut-off time must be changed whenever the speed is changed. Undoubtedly the most favorable cut-off time can be best determined experimentally, provided the cut-off can be changed during operation.

Conclusion

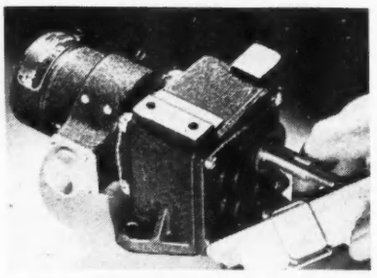
The proposed working method of an engine with controlled exhaust, turbo-supercharger and variable scavenging period solves two important problems of modern engine design: the problem of the economical scavenging-air compressor and of the economical scavenging system, and also the problem of an automotive engine capable of carrying considerable overload for short periods.

The proposed method of operation is of general significance and may well find wide application in marine engines and in engines for altitude flying.

Power Package for Aircraft

A new driving mechanism for use in aircraft subassemblies, has been announced by the General Electric Co., Schenectady, N. Y. It is called, by its makers, the Power Package, and is built to various specifications, depending on the particular application for which it is intended. Designs are available for bomb-door operation, landing-gear and wing-flap operation, and operation of control and protective devices.

The power package may combine in one unit as many items as a motor, brake, clutch, and limit switch as well as indicators, gears, and whatever else is required to do a specific job. Power ratings are from about 1/100 hp. to 3 hp. A planetary gear system permits the use of a magnetic brake in the power package for some applications. The brake is of the quick-acting friction type and stops the motor quickly to prevent overtravel and consequent jamming of the driven assembly. When the power is off, driven equipment is locked in place by the brake, to eliminate creeping of such subassemblies as landing gear.



The General Electric Power Package for aircraft application.

Fuels and Lubricants Discussed at Tulsa

THE S.A.E. National Fuels and Lubricants Meeting was held at the Tulsa Hotel, Tulsa, Okla., Oct. 22-23. The program again provided for morning, afternoon and evening sessions on both days, the evening sessions being dinner sessions at which subjects of a somewhat less specialized and technical nature were dealt with. At the first dinner session President A. W. Herrington of the S.A.E. spoke on the War on Wheels, while C. B. Veal explained the relationship of the recently-formed Cooperative Research Council to the petroleum industry. At the second dinner session there was a debate between teams from Oklahoma University and Oklahoma Agricultural and Mechanical College on the subject: Resolved that The Two-Cycle Diesel Engine is to be Preferred When Compared with the Four-Cycle Diesel Engine for Automotive Purposes.

Two papers were read at each of the morning and afternoon sessions, with the exception of the last one, at which only a single paper was presented. Of these seven papers five related to lubrication subjects, one to a fuel subject, and one to the all-inclusive subject of petroleum products. The two papers presented at the opening session had a definite war-slant. Following are brief abstracts of some of the papers that were read.

Gasoline Engine Exhaust Odors

A STUDY of the odors produced by gasoline engines under conditions of deceleration was dealt with in a paper by J. J. Mikita, Harry Levin and H. R. Kichline of The Texas Co. The subject of exhaust odors of gasoline engines is of special importance in the operation of buses. It is well known that when a bus is brought to a rapid stop, the engine exhaust often has a pungent odor which is annoying to passengers and pedestrians alike. In the study it became necessary to develop a simple laboratory engine test that under controlled conditions would produce exhaust odors similar to deceleration odors; to provide a convenient chemical substitute for the disagreeable task of smelling exhaust samples for odor intensity, and to determine the effect of certain operating variables and fuel volatility on deceleration odor. A six-cylinder bus engine and a CFR engine equipped with a standard carburetor were used in the tests.

Disagreeable odors in the exhaust occur particularly while the bus is being slowed down with the throttle closed and the clutch engaged. Under these conditions the engine is being driven by the vehicle, and combustion in the cylinders proceeds with difficulty. The exhaust under such conditions has an odor reminiscent of that of aldehyde, which is an intermediate product of combustion, and it has long been known that aldehyde in the exhaust is the chief cause of its offensive odor.

Samples for odor rating and aldehyde determination were obtained with the equipment shown in Fig. 1. Gas for aldehyde determination was taken from the exhaust pipe a short distance from the end of the manifold *A*, passed through a water-cooled condenser *B*, three traps *E* immersed in dry ice and chloroform, and through an orifice-type meter *F*. The gas was drawn at the rate of approximately ½ cfm for fifteen one-minute intervals, the condensate being ample for the test. Preliminary experiments demonstrated that the portion of exhaust gas which passes uncondensed through this train does not have the disagreeable odor. The sample taken for chemical determination of aldehyde was the combined condensates from the condenser and traps, being blended after rising to approximately room temperature.

Samples for odor intensity rating by smell were taken from the exhaust pipe by passing the gas through a quart bottle *H* immersed in cracked ice and water *G*, and through an orifice meter F_1, the gas and condensate remaining in the bottle being used.

Egerton has shown that the aldehyde content of the burning charge increases to a maximum value during the early stages of combustion in an engine cylinder, and that when combustion is complete the aldehyde content is low. With lean mixtures and consequent slow combustion, aldehydes are present in the exhaust gas because combustion is not completed in the cylinder. For a somewhat similar reason large quantities of aldehyde are found in the exhaust gas during closed-throttle operation at high speed. The results of the tests showed that both the aldehyde content and the intensity of the exhaust odor increase as the mixture becomes leaner.

Objectionable exhaust odor can be reduced by using a very volatile fuel, but only at the expense of increased (volumetric) fuel consumption, because of the lower specific gravity of the more volatile fuels. An increase in the amount of heat supplied to the manifold also will help. Practical experience has shown that with buses that have been in service for a long period, a reduction in the exhaust odor intensity often can be effected by cleaning deposits from inside the manifold, thus eliminating the material which traps fuel during wet mixture conditions. Adjusting the idling mixture to the leanest possible limit also reduces the aldehydes in the exhaust gas during de-

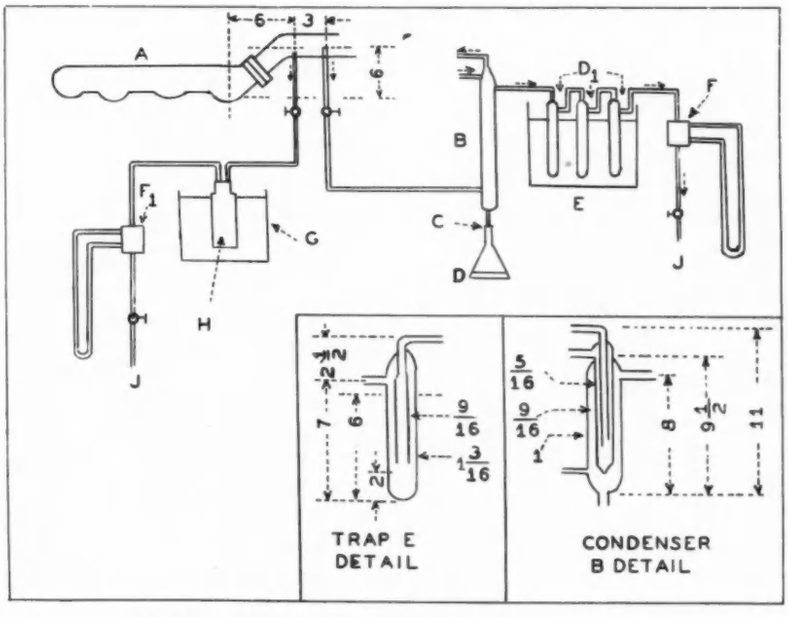


Fig. 1—Apparatus for collecting exhaust samples.

A, exhaust manifold, **B**, water-cooled condenser; **C**, gas-tight connection; **D** and D_1, condensate samples; **E**, traps in bath of dry ice and chloroform (—60 F); **F** and F_1, orifice meters; **G**, bath of cracked ice and water; **H**, sample for odor determination; **J**, to vacuum line.

celeration. A mechanical device that cuts off the fuel or ignition during deceleration should be helpful.

New Method for Evaluating Piston Skirt Deposits

TWO devices employed in evaluating lacquer deposits on engine pistons and for photographing the form, location and intensity of these deposits were described in a paper by H. R. Luck, T. A. Rogers and A. G. Cattaneo, all of the Shell Development Co., Emeryville, Calif. The devices referred to are in use in the authors' laboratory. Evaluations of the lacquer deposited are made by an application of the Eastman reflection and transmission densitometer, which was developed by Eastman Kodak Co. for use in the graphic-arts industry. The principle of the instrument is illustrated by Fig. 1. Two narrow beams of light are obtained from a common source. One beam is directed at a small area of the object to be tested, while the other is passed through a calibrated optical absorption wedge. The two pencils of light are brought together on a mirror surface to permit direct comparison of their intensities. The beam passing through the wedge can be varied in intensity by moving the wedge from a position of zero absorption to a position of almost 100 per cent absorption, and the wedge is moved until the intensity of the beam passing through it matches that of the beam reflected from the surface of the object.

Initial calibration of the instrument is accomplished by adjusting the light source for balance on a standard white card, with a red viewing filter over the eye piece. The red filter reduces the difficulty of matching the intensity of the gray light from the optical wedge with the reddish-brown light reflected from the piston-skirt surface. A scale attached to the optical wedge is calibrated in terms of reflection density.

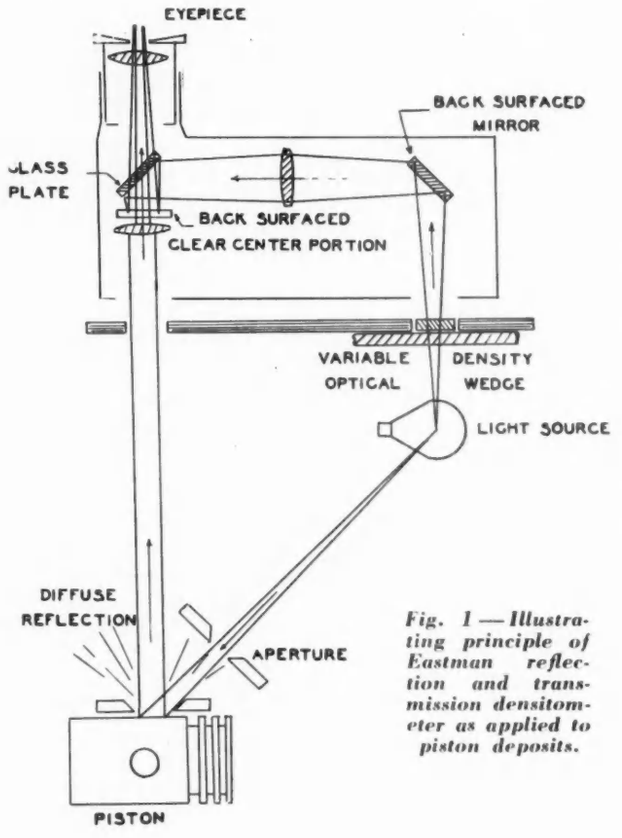


Fig. 1 — Illustrating principle of Eastman reflection and transmission densitometer as applied to piston deposits.

The result is expressed in terms of the reciprocal reflectivity $1/R$, where R is the reflectivity of a surface under 45-deg. illumination. Reciprocal reflectivity is related to reflection density by the equation.

$$1/R = 10^D = \text{antilog } D.$$

If the surface is perfectly white and a perfect diffuse reflector, $R = 1$ and $D = 0$, while if the object is quite black, $R = 1/100$ and $D = 2$. The range $D = 0$ to $D = 2$, which is covered by the densitometer, includes practically the entire density scale of piston deposits.

The piston to be evaluated is scanned at a predetermined number of points, and the readings are converted to reciprocal reflectivity values. The average of these values is called the piston rating. A clean piston may have a rating of close to zero per cent, while an extremely black piston may approach 100 per cent. The final rating is the difference between the rating of the clean piston as it goes into the engine, and that of the lacquered piston as it comes out of the engine at the end of the test run. The method is said to give closely-reproducible results, as indicated by the fact that in a typical case, where measurements were made on the same piston by four different persons, the resultant ratings were 2.74, 2.82, 2.78 and 2.72 respectively. Various difficulties that may be encountered, and precautions that must be observed in the application of this method were discussed by the authors.

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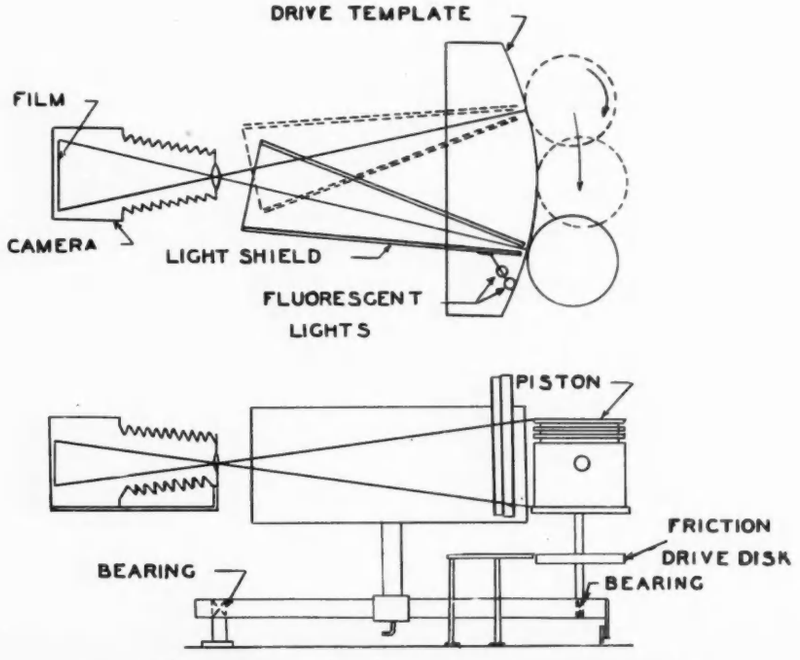


Fig. 2—Schematic drawing of piston-photographing machine.

PRODUCTION LINES

Industrial Statistics

Add to your listing of recent texts on statistics, a book entitled "Industrial Statistics," written by H. A. Freeman of M.I.T. The text has been so developed as to provide a method of approach to the design and analysis of experiments carried out in manufacturing plants as well as in scientific laboratories. Among other things it deals with the elements of quality control and manufacturing under conditions of statistical control. Interesting feature of the book is that each chapter is divided into two distinct parts—the first, in large type, for students and others who may not have complete mastery of the mathematics involved; the second part, in small type, provides a more thorough mathematical background for the principles that have been outlined. The book is published by John Wiley & Son.

Tooling Information

One of the most valuable contributions to the Automotive Council for War Production is its Tooling Information Service. It began its activity modestly but has gradually enhanced the service to a point where it has become invaluable in the war effort. After months of experimentation, the Tooling Information Service initiated in October a weekly report listing a large group of companies in the Michigan and Ohio areas, making cutting tools, gages, and jigs and fixtures. Apart from providing a current listing of these organizations, the report also gives the following information—(a) dimensional tolerances to which an individual company can work, (b) the back-log of orders in terms of delivery promises on new orders. The latter is most important since it enables a manufacturer to determine where it would be best to place his new orders with prospects of reasonable delivery. This reporting service should go far to ease the problem of procurement of tools and fixtures. And should be effective in preventing an unbalance of order-placing.

New Wrinkle

We are told confidentially that one of the leading manufacturers of glass has successfully produced a line of glass gages to take the place of the conventional steel gages for plug and ring gage purposes. This development is still in the experimental stages. However, the preliminary work has indicated that the glass gages last longer, are easier to handle, and do the job equally as well. This is, indeed, something well worth watching, what with the critical shortage of tool steels and, in fact, of all steels.

Slide Rule

Carpenter Steel has issued a form of slide rule giving pertinent technical data on stainless steels. One side gives the principal data on specific grades of Carpenter alloys; the other side compares the engineering properties of the alloys, arranged in three generic groups. Be sure to get this handy guide for your desk. Ask us for it.

Spark Testing

To assist your men in becoming acquainted with spark testing of tool steel, a handy wall chart suitable for tool rooms has been prepared by Carpenter Steel. The chart shows how to identify the general character of steel and is helpful in separating mixed scrap. Ask us for your copy.

Grinding Tips

A comprehensive bulletin describing the latest methods of grinding rifle drills has been developed by W. F. & John Barnes and is ready for your desk. This booklet contains complete detail instructions, supplemented by numerous illustrations. Considering the wide use of rifle drilling today, this booklet should be of great value to production men throughout the industry.

Lathe Operation

Worth while contribution to the wartime training program is a sound-and-color film on the operation and use of turret lathes sponsored by the Gisholt Machine Co. Subject matter of the film includes comparison of the turret lathe with other metal working equipment and detailed sequences illustrating basic operations performed on a turret lathe. It's a 16 mm. film. Gisholt will make it available—free of charge—on request, to trade schools, technical schools, manufacturers, etc.

White Metals

Recent issue of *Inco*, a publication of the International Nickel Co., outlined some simple tests for the identification of white metal scrap. Obviously the best method to insure complete recovery of high nickel alloy scrap is to segregate at the bench or machine at which it originates. However, since this cannot always be done and, further, because there is always a possibility of a mix-up in storage, *Inco* provides a key to identification, using relatively simple and inexpensive equipment. Four tests—magnetic, nitric acid etch, test for copper with an iron or steel nail, and a cupric chloride solution test—are employed. The application of these tests to nickel, monel, nickel-silver, steel or cast iron, Ni-Resist, straight chromium stainless steel, 18-8 stainless, and Inconel, is described and tabulated in the article. This information should be of greatest interest in the light of the current scrap recovery drive.

For Sprayed-on Metal

Interesting development in the field of Metallizing is the discovery that an unorthodox tool form on a standard Carboloy tool bit produces a roughened surface of precisely the kind needed to assure proper keying of the sprayed-on metal. The Carboloy tool will cut alloy steel at the rate of 200 to 250 fpm. We are glad to pass this on to production men and maintenance men as something well worth noting.

Milling Practice

A new booklet on milling machine practice has been prepared by Cincinnati Milling Machine Co., and is ready for distribution. Text material stems from the work of Hans Ernst and Mario Martellotti, includes the latest information on the fundamental concepts of the process, a study of milling cutters, the use of cutters, discussion of milling machines. Ask us for your copy.

—J. G.

Ramsey Plant at Fruitport

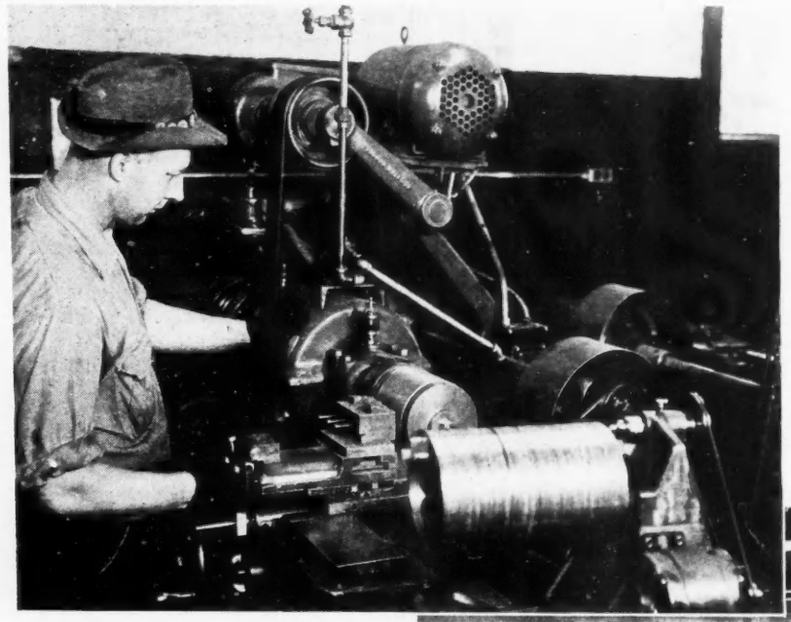
Notable for

THE Ramsey Accessories Mfg. Corp. of St. Louis, Mo., has just completed conversion of their Fruitport, Mich. division—the Ramsey Mfg. Co.—to the manufacture of aviation piston rings of various types. The Fruitport plant was constructed only within the last few years and already this Ramco plant is notable for some of the most modern equipment known to the piston ring art and exemplifies production methods stemming from some twenty years of piston ring experience.

Paradoxically, the relatively simple piston ring is one of the most intricate engine parts to produce, from the standpoint of equipment, methods and quality control. It starts as a single casting, but after the first cycle on the machines, it becomes a round shape of thin narrow ribbon of spring-like character. For a high output airplane engine this ribbon is some 18 in. in length.

The function of the finishing operations is not only to correct any imperfections in the casting, but to remove all internal strains set up by the production process, and to produce a ring which is perfect dimensionally and also in finish and flatness, when compressed into a ring groove.

When contrasted with conventional ring procedures, the making of aircraft quality rings involves an en-



(Above) Chard lathe with special attachment for cam turning of large piston rings, using Carboloy tools. By this procedure the rings are given proper shape (plus circularity) so as to fit perfectly when assembled in the cylinder.

(Right) General view in the inspection department at Fruitport.

Its Modern Equipment

tirely different problem. In the first place, there is the matter of size: it is estimated that for the same plant, the man hours required in the production of aircraft rings ranges about five to one in comparison with normal ring manufacture. Then there are the requirements of unusually fine finish and close tolerances. Some idea of how these run may be gained from the following generalized specifications:

Surface finish of the order of six micro-inches (r.m.s.).

Flatness held to 90 per cent of area of ring.

Tension held to plus or minus one pound.

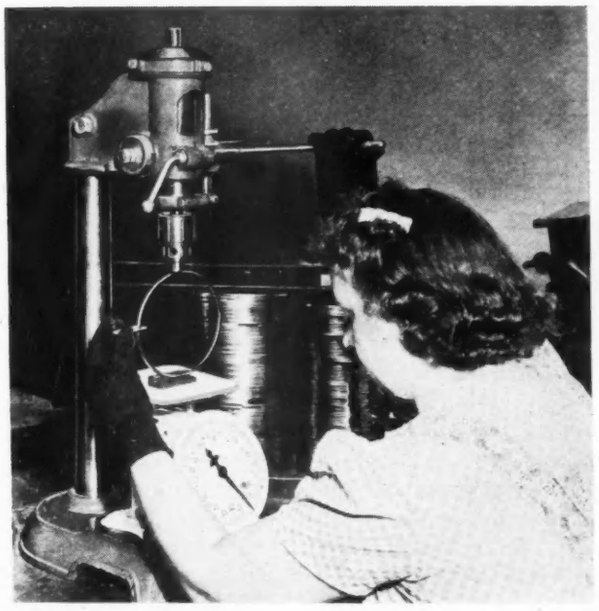
Outside diameter must have light tight contact when ring is in gage of cylinder bore diameter.

Must be absolutely free of burrs, scratches, foundry defects and other imperfections.

Any distortion caused by the specifications and design of aviation rings, and by the manufacturing operations necessary to meet or beat the specifications, must be so controlled and counteracted in the process as to produce perfection of fit and flatness when assembled into the ring groove or into an inspection gauge.

The Ramco Fruitport plant has developed a number of specially designed machines, capable of holding surface finish to six micro-inches (r.m.s.) and extreme flatness, while operating with relatively high productive capacity.

(Center) This battery of Atlas lathes is used for chamfering the inside edges of oil rings.



Inspection operation—measuring ring tension with load applied at points 90 deg. from the gap.

Carboloy tools are employed for all turning and boring operations, contribute to maximum productivity, excellent finish and increased life of tools between grinds.

Perhaps the best way to visualize how aviation rings are made is to consider the operations from the rough casting to the finished product. For an oil ring these operations are about as follows:

Rough casting is snagged and inspected visually.

Rough side grind. Sufficient passes are made to remove excessive stock and produce initial flatness.

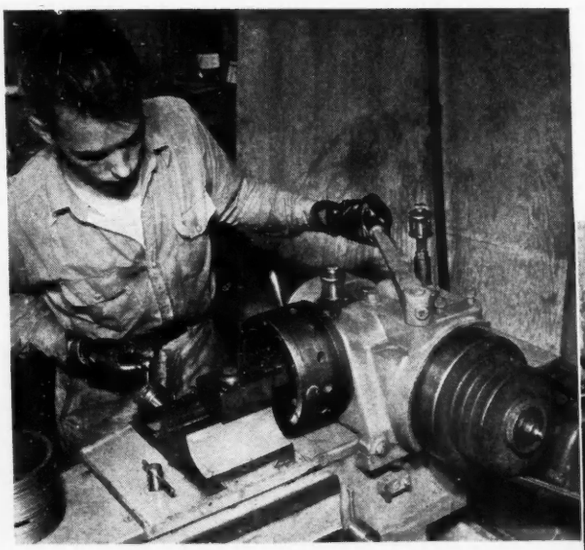
Semi-finish ground to size and parallelism of sides.

Cam-turning of O.D. This is done on a special lathe equipped with cam turning fixtures designed by Ramco engineers.

Up to this point the ring is still a closed casting. It is now placed on a special milling machine of Ramco design, which cuts the free gap designed in the ring pattern to produce ring tension along with proper fit in cylinders.

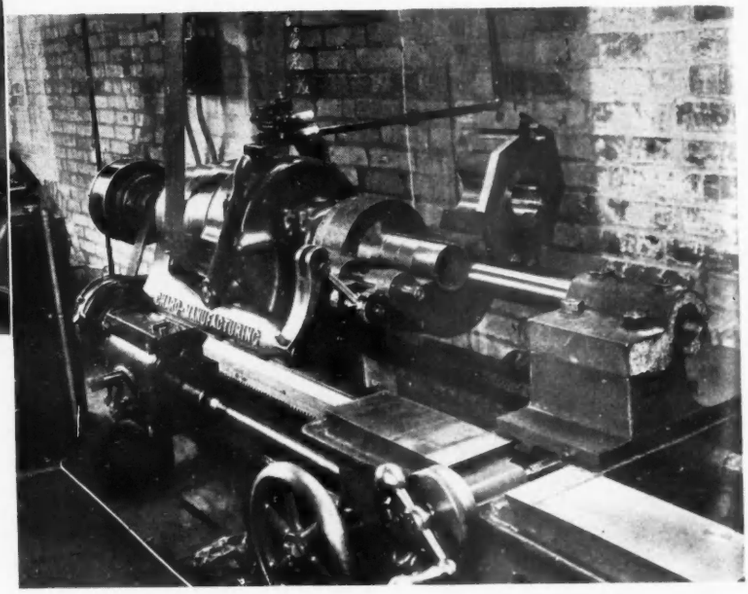
The ring now possesses spring characteristics. It is

Special double-head milling machine developed by Ramco for ring gapping. (Patented.)



(Left) Straddle-turning four-degree wedge face on airplane rings.

(Below) Chard lathe for boring rings, view shows special pot chuck open for loading. Boring is done with Carboloy-tipped fly-cutter.



now rough bored, then compressed and rough turned on the O.D. The ring then is scalloped on a horizontal grinder indexing from point to point by means of an automatically operated fixture.

The undercut and O.D. radius are produced simultaneously in a setup on a small lathe, then the roughing cycle is completed by finish-boring.

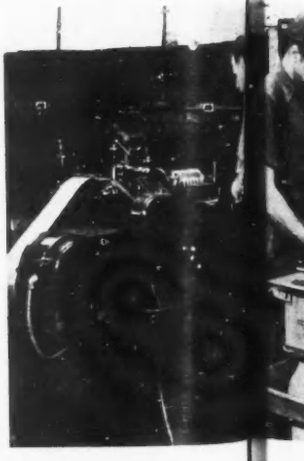
Now the rings go to the grinding department. Here each ring is fed into the special surface grinder for grinding to perfect flatness and also to obtain the specified surface finish.

Final operations including milling the final gap dimension, burring, and final inspection.

The routing outlined above covers only the operations on an Oil Ring. Naturally there are variations in producing other types of rings. For example, the scraper ring has a beveled face to increase unit pressure and, in this case, the rings are mounted on a special arbor fitted with Carboloy tools, for forming the angular face. Also, some compression rings are of the wedge type, having sides tapered at a four degree angle, the side grinding requiring special fixtures on an Arter grinder.

As mentioned earlier, quality control is one of the most exacting operations to be found anywhere in the field of manufacturing. To illustrate we list below the steps in inspecting a Dual Oil Control Ring:

Break top and bottom end corners.
Break inside end corners.
Break should end corners.
Inspect corners.
Inspect radius turn—outside edge—foundry and machine defects.
Inspect inside chamfer—inside edge.
Inspect scallops—spacing, and foundry and machine defects.
Inspect surface finishes.
General inspection — check on all above inspections.
Amplify thickness—two end points and rear.
Weigh ring tension.
Check shoulder height.
Check plus circularity.
Light test for circularity.
Light test for flatness.
Wash in cleaning solvent.
Dry by hand.
Acid etch identification.



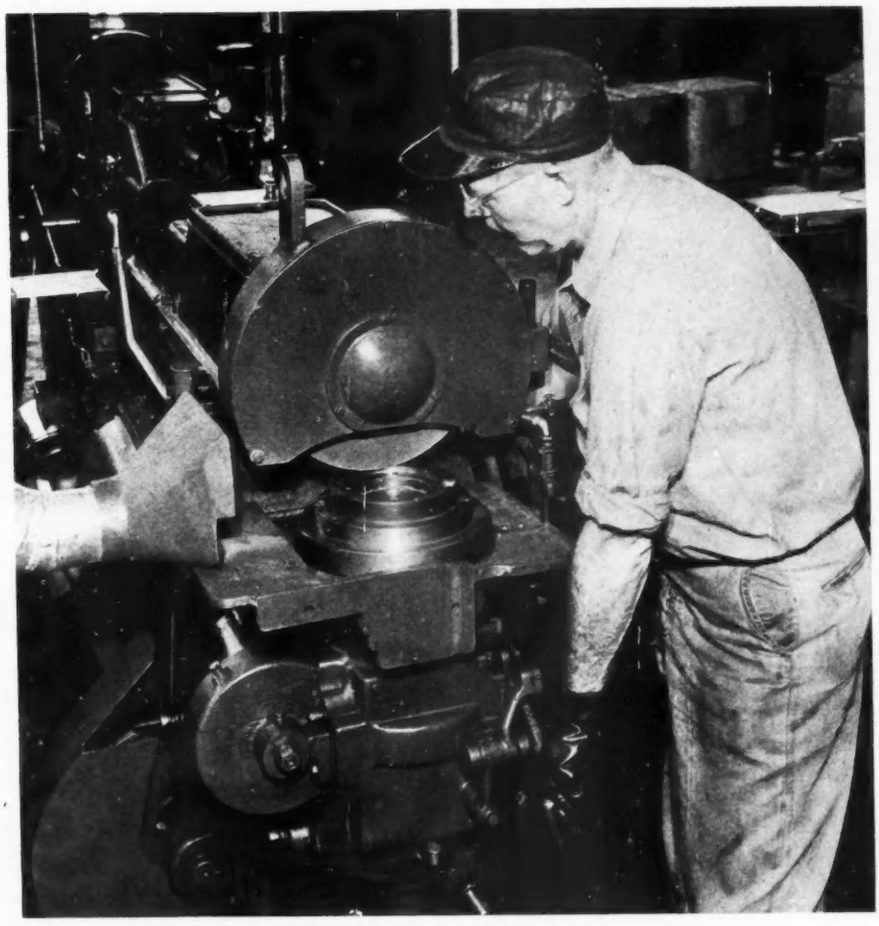
Surface smoothness is measured by Profilometer, an electrical instrument reading in millionths of an inch.

Neutralize etching.
Oil dip (rust preventive).
Rack to dip.
Pack for shipment.

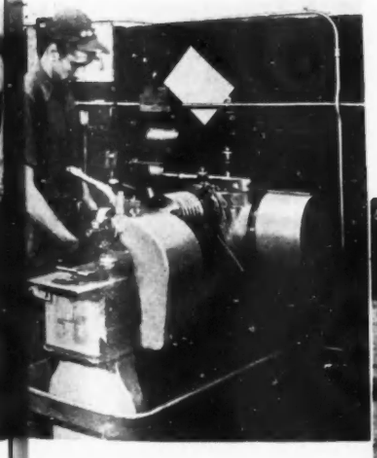
The foregoing is intended as a quick look behind the scenes of one of the most modern manufacturing setups for the making of aircraft rings. The mere fact that this article can be written in some detail is a tribute to the cooperative spirit that exists today in the piston ring industry in the interest of speeding the war program.

Our word picture is supplemented with a pictorial section consisting of specially selected views of the latest equipment and tooling developed for the Ramco project.

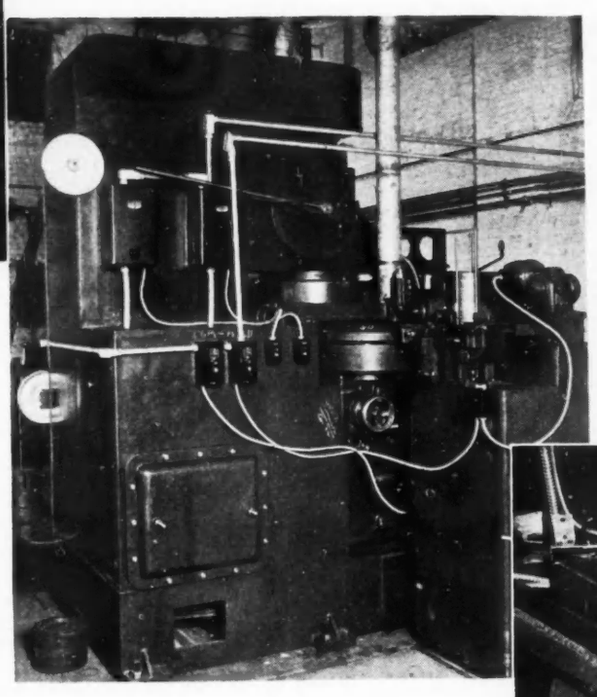
Finally it may be noted in passing that the broad experience gained in the mass production of aircraft quality piston rings needs must be reflected in the post war progress of the piston ring industry. Certainly, it is only reasonable to expect that the lessons learned today will be applied to the manufacture of rings for civilian use of such quality as to revolutionize our current conception of passenger car engine performance.



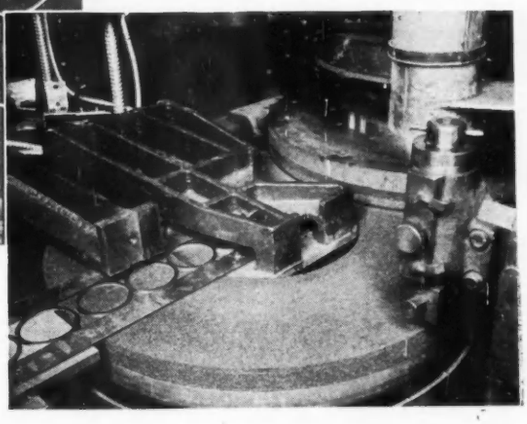
Sides of wedge rings are ground on this rotary grinder.



(Center) Turning radius and undercut on outside of ring surface, using Carboloy tools.

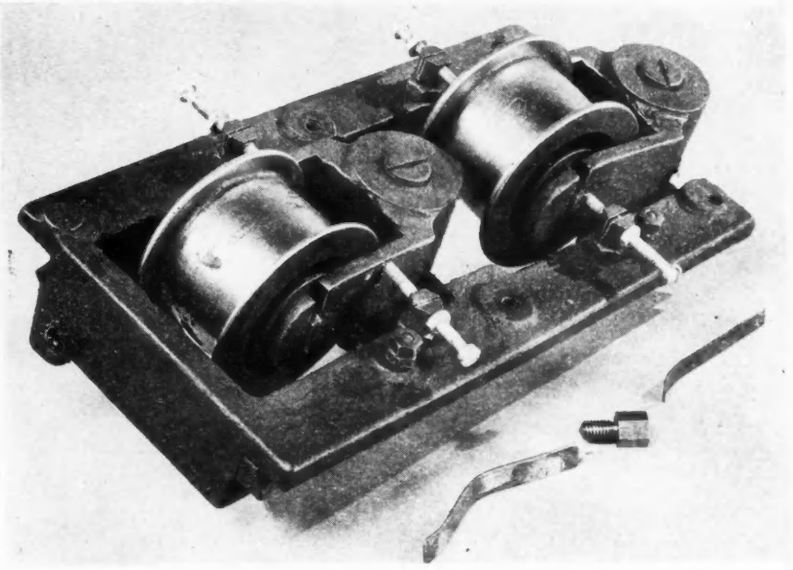


(Right) Ramco Micro Lapper, specially designed for producing final side finish on Ramco airplane piston rings.

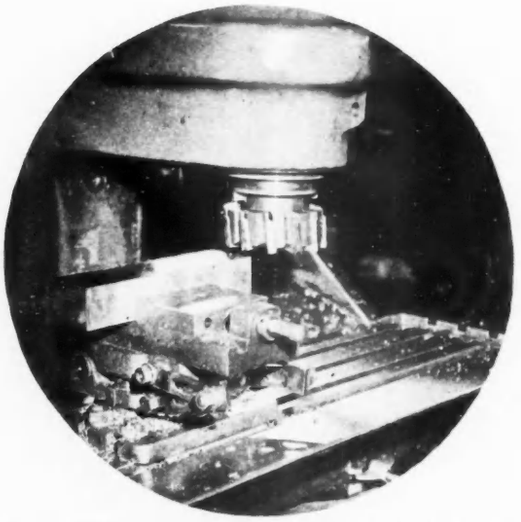


(Right) Close-up of Ramco Micro-Lap operation.

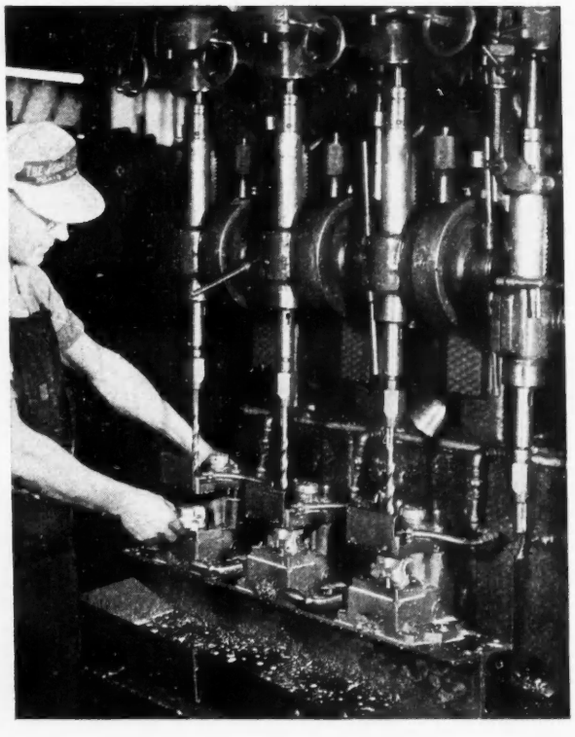
Short



The guiding tightener pulleys on top of sensitive drill presses may be kept in line, and the belt life lengthened, by replacing the flat steel springs provided to keep the pulleys in position by adjusting screws, according to a note from the Westinghouse Electric & Manufacturing Co. A hole is drilled through the spring-retainer stud, and tapped. The belt is run over the pulleys in the usual manner, and the latter are allowed to take whatever position they will. The set screws are then tightened and secured in place by means of lock nuts. As long as the set screws remain tight, the pulleys cannot change their position. In this way the belt is made to run true, and its life is said to be lengthened considerably.



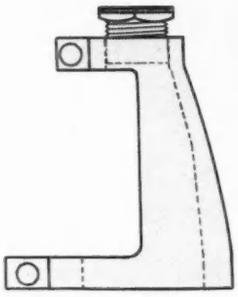
Increased production rates have resulted from a new method of surface milling recommended by the Firth-Sterling Steel Company, McKeesport, Pa. Use is made of Firthite sintered-carbide-tipped inserted blades, with both the rake and helix angles of the mills negative up to 10 deg., with the cutters operating at speeds up to ten times those normally used, and with resulting feeds up to six times those of conventional high-speed mills on hardened-alloy-steel parts. The process, known as hyper-milling, shears off the metal.

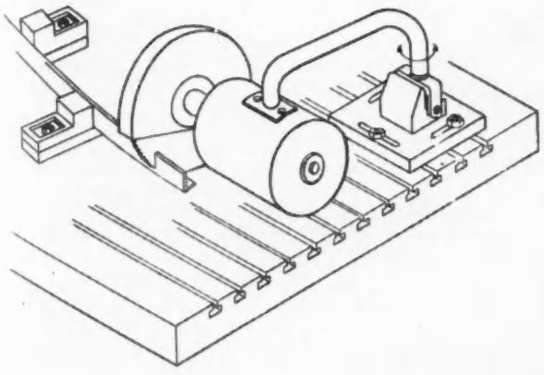


By bolting three drill jigs to the table of a four-spindle drilling machine, as shown in illustration at the left, the necessity of centering the jig under the spindle for each operation has been eliminated and production stepped up considerably. The operator lifts the jigs by raising the crank with his left hand and replaces the pieces to be drilled with his right hand. When the spindle has descended a predetermined distance it returns automatically. A burring operation is performed with the spindle at the right during the drilling time (Westinghouse Electric and Mfg. Co.).

Cuts

More on the next two pages





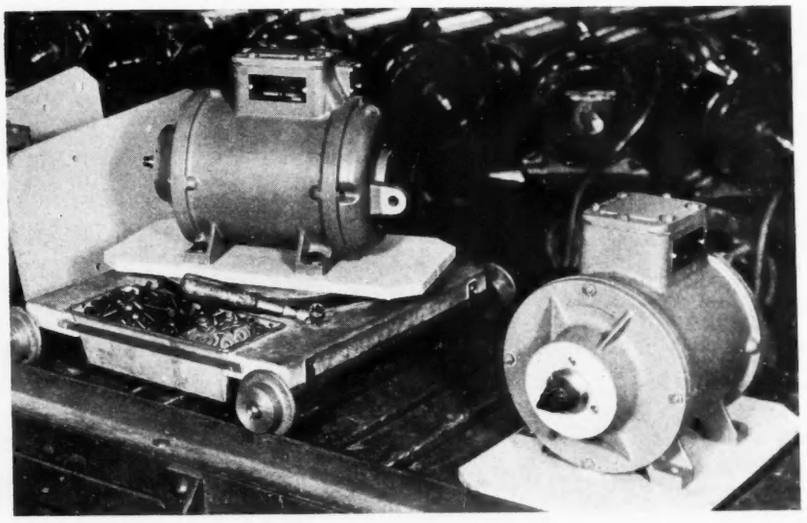
A new counter-sink tool with adjustable stop has been developed at the Consolidated Aircraft Corp. It will eliminate the scratching of materials and the wear that occurs when using an ordinary stop counter-sink tool, which is being used in sheetmetal, machine-shop and detail assembly departments, also eliminates wear on stop bearings, which usually require frequent adjustment.

Illustrated at the left is an improved method developed at the Consolidated Aircraft Corp. for cutting drawn and extruded sections other than flats to the exact size of a sample furnished. Angles are brought from the forming department and the sample is laid out on the table as illustrated by the accompanying sketch. Lay-out blocks then are brought to bear on the sample, laying out the contour, and the workman then swings the saws down on the piece. The saw has a universal mounting and will accommodate all types of stock. Although only one saw is shown, it is planned to supply two per table. Jobs can be handled by one man, except in the case of unusually long pieces, which constitute only about 5 per cent of the work handled. With most sections both saws are operated simultaneously. In addition to providing the saw with guides, it is necessary to provide a quick-stopping motor, for the sake of safety.

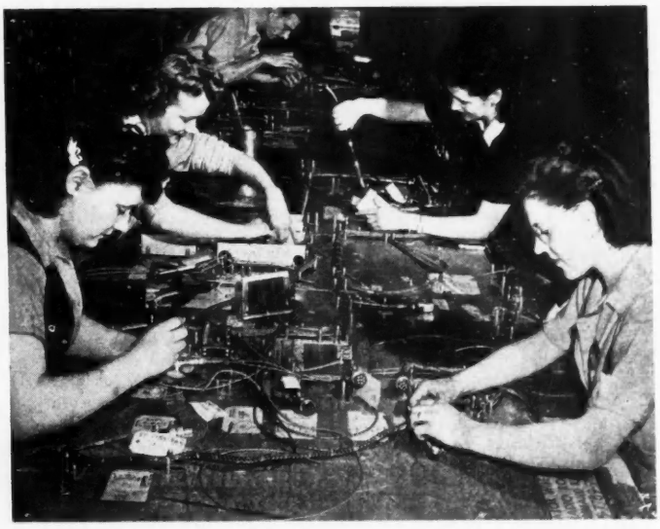
WHEN production of Army P-39 Airacobras was to be greatly increased at the Bell Aircraft Corp. plant, the taping of flexible conduit to prevent it from chafing presented quite a problem. Up to that time the conduit had been taped by hand, but a great deal of hand work was required, so a power-driven taper was developed to do the job. To tape such conduits rapidly, a mandrel is slidably mounted in pillow blocks and the conduit to be taped is slipped over it. A friction disc, driven by a motor, is used to drive the machine. A male conduit-connector makes it possible to secure the conduit to the disc so that it rotatoes with the latter. Once winding of the tape has begun, the friction disc serves as a clutch, engaging with the motor and rotating the conduit while the tape is being wound on. A great increase in production and greater uniformity of product are said to have resulted from the introduction of this device.

Lockheed production engineers designed this special support to speed the output of pilot nacelles for Lightning P-38 warplanes. The nacelle can be rotated and locked in any position. Casters permit easy handling of the unit.

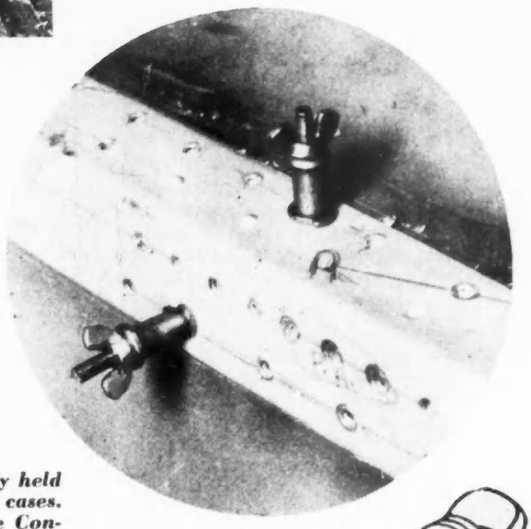
Short Cuts



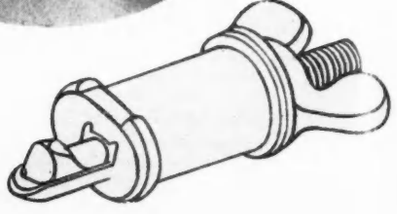
In assembly operations performed on conveyors it is often necessary to turn the apparatus being assembled so that it can be worked on from both sides. A case in point at the Westinghouse Small Motor Division is the assembly of skids or wooden base plates to the feet of small motors. To expedite the work, a dolly mounted on a turntable rolls along the side rails of a slat conveyor. (See illustration at upper left). After the motor has been placed on its base plat on the dolly, two nuts on the base plate bolts are tightened. The assembly is then revolved on the turntable, and the two nuts on the opposite side are run down and tightened. The assembly is then slid off the dolly onto the conveyor and the dolly is ready for the next motor.



Boeing Aircraft Co. engineers have devised a plan that eliminates wiring conduit from the plane. Formerly it was necessary to pull wires singly through conduit, which took a great deal of time and made the wiring operation the bottle-neck in aircraft assembly. Now complete wiring assemblies are put together in sub-assembly operations which can be performed by girls with little experience. These wiring assemblies are made on large plywood boards. Bends in the wiring are indicated by pegs screwed into the boards. A red wire follows a certain course which is painted on the board; red and black wires follow another course. When they leave this department the wiring assemblies are complete and need only be attached to the proper portions of the ship.

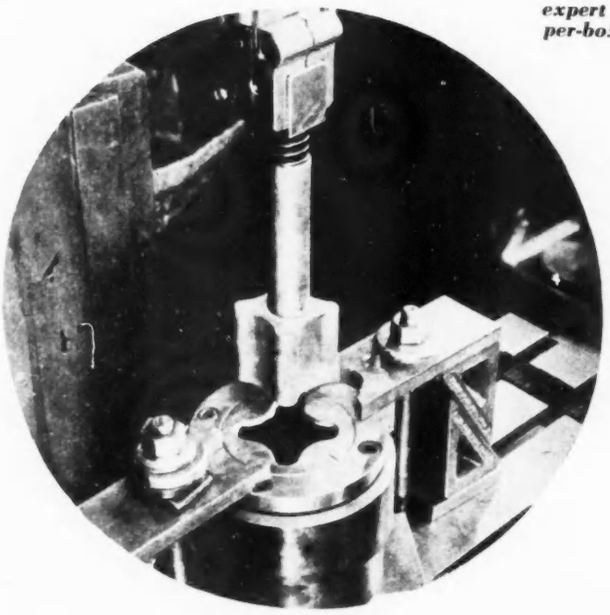


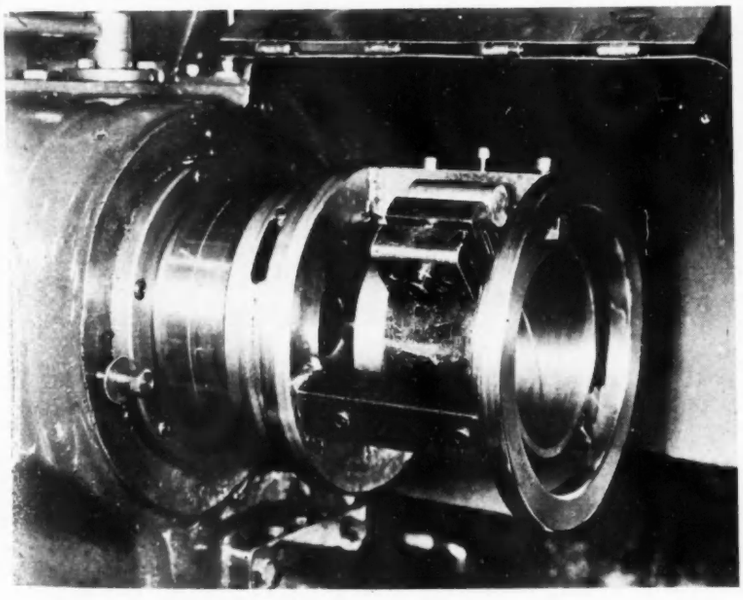
When two heavy plates are to be riveted together, they are usually held together by bolting, as the ordinary Cleco does not hold in many cases. The thum-screw Cleco illustrated at the right was evolved at the Consolidated Aircraft Corp., and is claimed to hold as securely as a nut and bolt. Its advantage over the nut and bolt is that it saves time in cases where two men would be required to tighten the nut and bolt—that is, on large assemblies where there must be one man on each side. In such places this Cleco may be inserted on one side and tightened by means of a Yankee screw driver attachment, thus saving the time of one man. These thumb-screw Clecos are made from broken Clecos. While shown only in one size, they may be made in all sizes that Clecos come in.

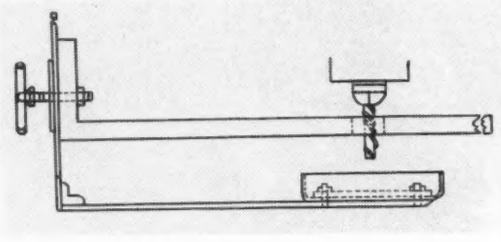


Continued from the preceding page

Lapping of intricate high-speed steel compression dies with a Universal Slotmaster requires a man's time only while the job is being set up. (See illustration in circle at left). In addition to making possible a time saving, this method is claimed to eliminate all of the inaccuracies, such as bellmouth of hand lapping, which latter is a tedious kind of work that is said to be never quite satisfactory even if done by an expert mechanic. The lapping arbor is mounted in the standard clapper-box tool-holder of the Slotmaster and is gradually worked into the die opening, aided by pressure from a coil spring.





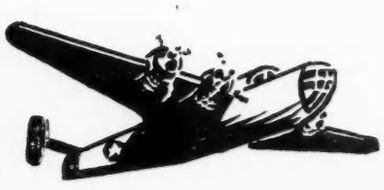


If a router table is used by many employes and it is impractical to assign each of these employes an eye shield, the suggested transparent shield may be attached to the router table bed. The shield, a Consolidated Aircraft Corp. development, consists of a discarded brake drum with a Plexiglas disc attached to it as shown in the two illustrations above.

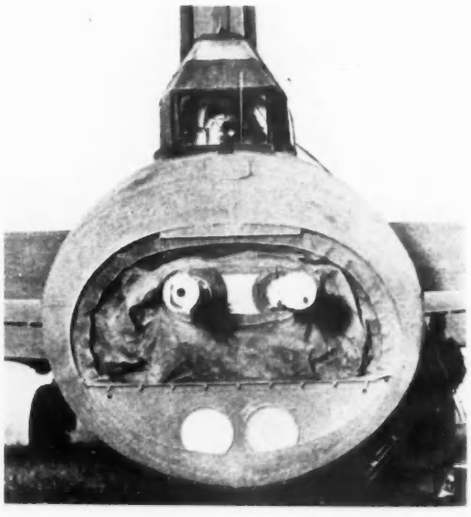
To make it possible to obtain true cylindrical bore in thin-walled work, a special chuck (see illustration above) was developed in the Westinghouse plant in Lima, Ohio. Such work usually is held in three-jaw chucks, and the pressure of the chuck jaws necessary for driving is sufficient to leave a distortion of from 5 to 6 one-thousandths after the work is removed from the chuck. In the new chuck there are three entering and supporting arms which are bored out to the finished diameter of the cylinder. Two of these supports are fixed, while the third is provided with release screws to facilitate loading and unloading. In the face of the three jaws is turned a wide groove to accommodate a 3 by 1/16 in. flexible steel band with a 1/32-in. clearance. In use, the cylinder to be bored is placed in the chuck and the band is clamped tight around it. Since the steel spring is flexible, it conforms to the contour of the cylinder and provides sufficient friction for the drive without distortion of the work. The clamp and cylinder unit is then rotated to bring the clamp lugs in contact with a supporting arm

Two views of the top turret on a Boeing Flying Fortress.
Press Association Photo

American



Flying Fortress stinger turret.
Wide World Photo



Two views of the Sperry-designed spherical turret on the underside of Flying Fortresses. It is electrically operated, can revolve in any direction and is equipped with two 50-cal. machine guns.
Press Association and Wide World Photos

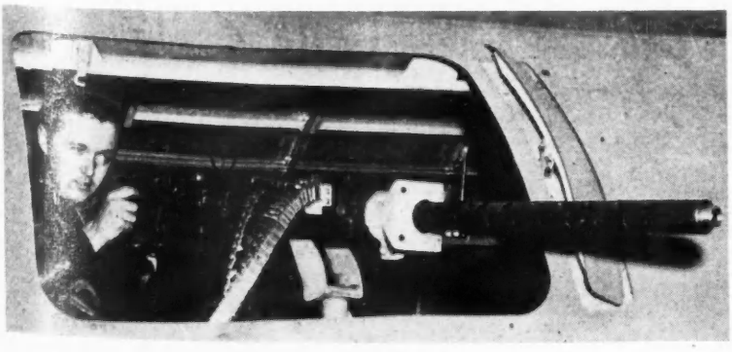
The German Junkers Ju 88 has twin gun turrets of this design at the rear of the cockpit nacelle.

Gun Turrets

(Right) This new gun turret is of Sperry design and is in production for Army Air Forces at a plant operated by the Briggs Mfg. Co. in Detroit. It is described as an aluminum ball about four feet in diameter and is equipped with two .50-cal. machine guns. It extends about two-thirds of its diameter out of a ship.

(Below)
North American B-25 and Consolidated B-24 bombers are equipped with top turrets of this Bendix type. Machine guns are .50-cal. size.
Press Association Photo

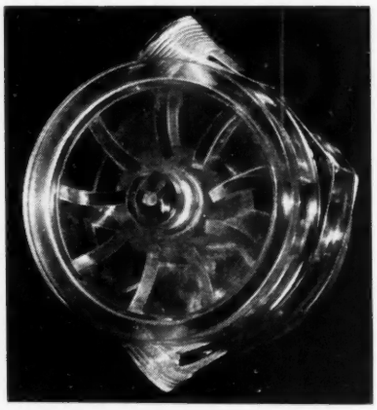
(Below)
Side gun on a Flying Fortress.
Acme Photo



Transparent Plastic Models

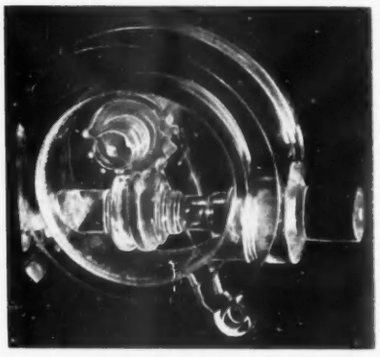
Facilitate Design and Research—

AN ENGLISH firm (Runcolite Co., London) is finding an increasing demand for engineering models in transparent plastics, the production of which it has developed as a separate branch to its normal activities in the fabrication of aircraft components in various plastic materials. The production of simple working models in transparent materials was originally conceived as an aid to instruction and demonstration. But lengthening experience in the production of these models indicated that their appeal was by no means confined to engineering students. They were found to be capable of providing assistance to both research workers and designers, and in some cases to production engineers. After much experimental work, it became possible to produce many different types of mechanical components in various kinds of plastic materials, each kind possessing characteristics demanded by the design, application and purpose relating to the particular case.



A transparent plastic centrifugal blower for studying the movement of gases under pressure.

Although the precise functioning of internal mechanism or the directional flow of gases or liquids, for example, may represent information highly to be desired, such information cannot be gained readily, if at all, owing to the lack of visual evidence. The latter is afforded, however, by transparent models, which also overcome any difficulty experienced ordinarily in judging from the drawings of a complex component whether or how the design will serve its intended purpose as a working unit. Sectioned models made of steel or other opaque material sometimes enable the movements of mechanical parts to be observed, but their limitations in this respect are obvious.



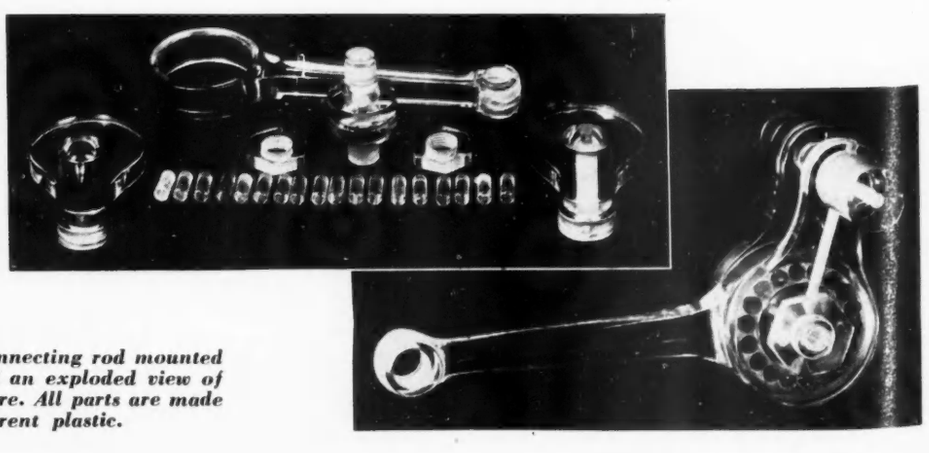
Steering gear in transparent plastic.

In the production of models for purposes of research, the Runcolite Co. works precisely to drawings provided by its customers, some of whom in certain instances require transparent casings only and supply their own metal internal parts. In other instances every part of the model is required in transparent plastic. The various types of plastic used by the Runcolite Co. have properties fulfilling, within limitations, the requirements of the operating conditions of the parts concerned, such as heavy loading, high speeds, temperatures, torsion and so on.

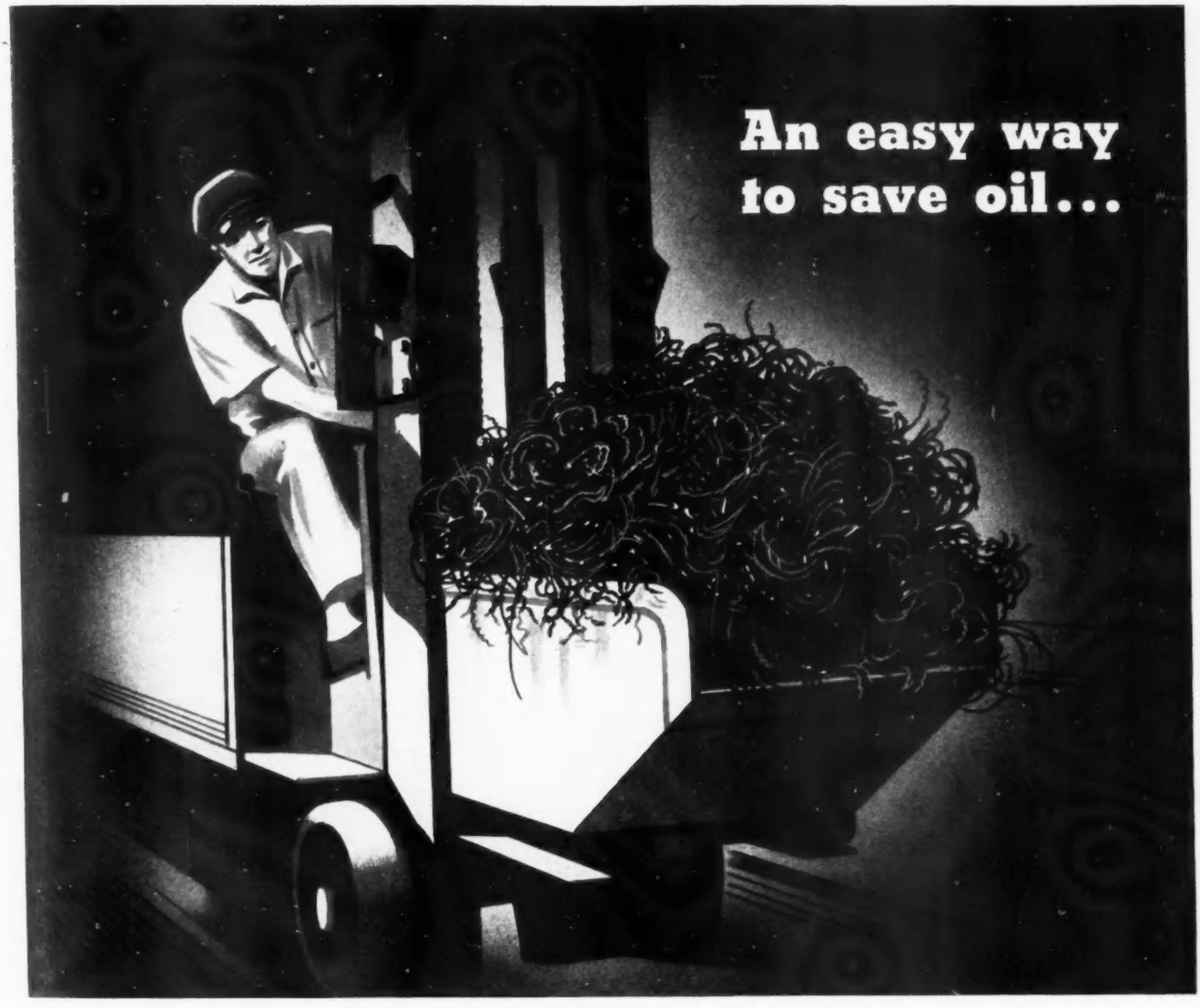
With regard to limits of accuracy in the working of these materials, this is stated to depend upon the intricacy of the work. It is possible to keep within a limit of 0.001 in. in the case of a short bore up to about 3 in. in length, for example, but, for anything beyond this, limits of plus or minus 0.004-0.005 in. are required.

Photographs of a few of the components supplied by the Runcolite Co. are reproduced herewith. These, it may be remarked, are among the comparatively simple

(*Turn to page* 96, *please*)



Built-up crank with connecting rod mounted on roller bearings and an exploded view of the parts are shown here. All parts are made of a transparent plastic.



Information supplied by "Automotive and Aviation Industries"

Through the simple expedient of a perforated false bottom in the chip car, a considerable amount of oil is reclaimed in one of the automotive plants, now converted to all-out war production.

The worker whose job it is to collect chips from cutting machines noticed, each time he dumped his chip car, that a quantity of oil which had dripped off the saturated chips, went down the drain.

He suggested that there be placed in the bottom of the chip car, or truck, a false bottom, perforated with numerous holes. Now, when he fills a truck, he lets it stand by the chip chute while he fills a second. When he returns, the oil in the first truck has drained to the bottom and is drawn off from a valve. Plant officials report that a substantial amount of oil is reclaimed in this manner.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company
500 Fifth Avenue • New York City

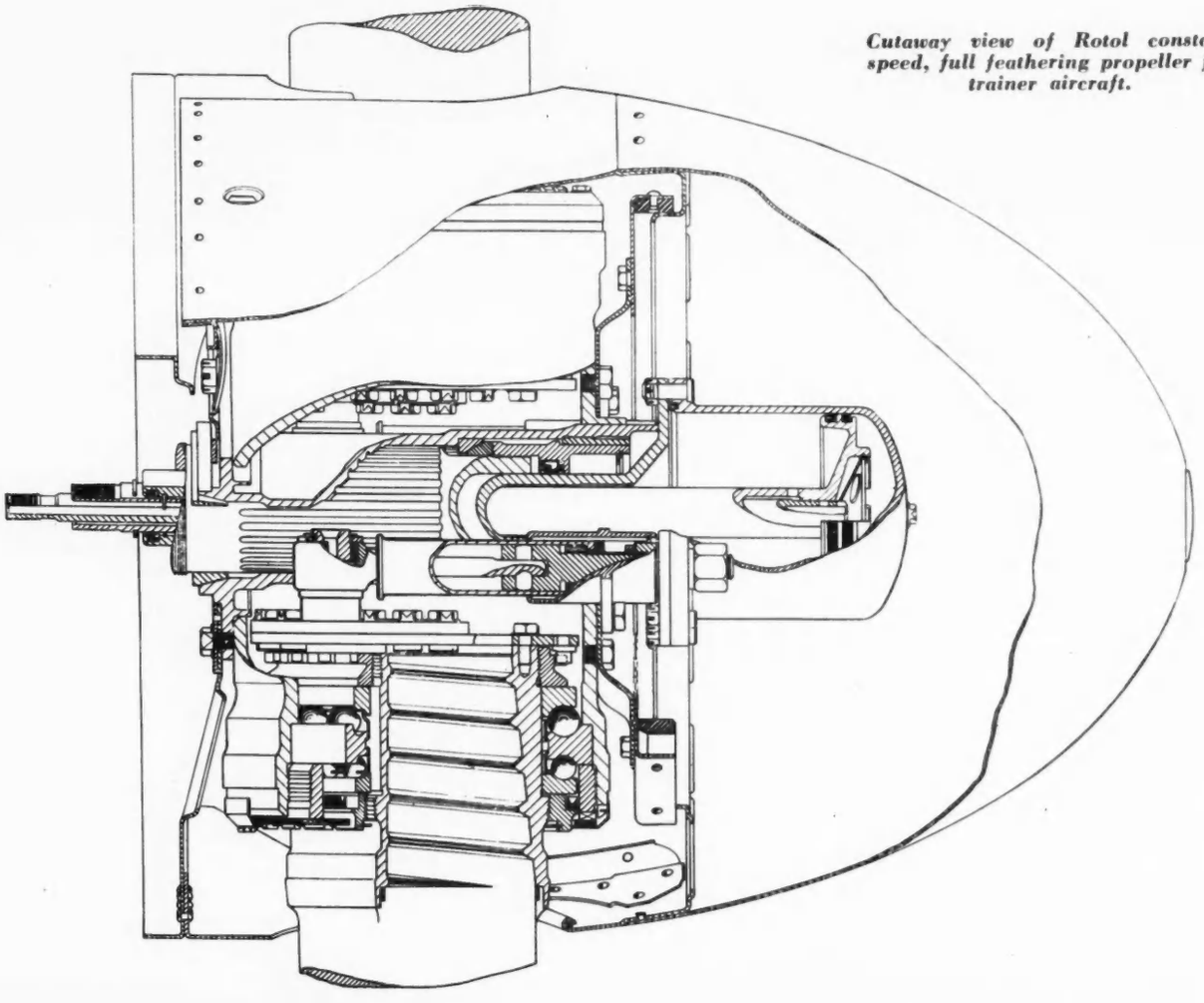
MOLY

New Rotol Propeller

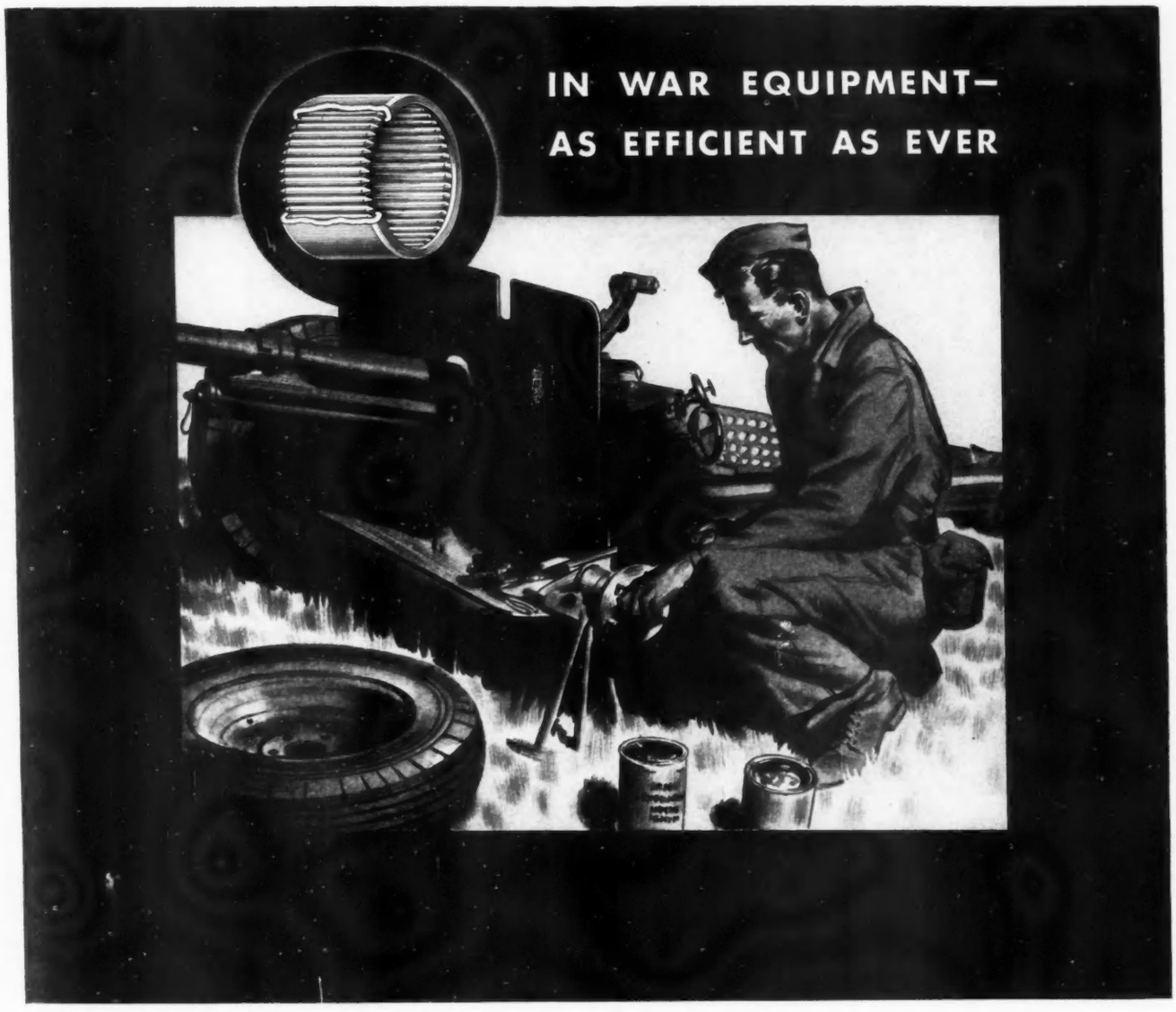
of full-feathering type for Trainer Aircraft

THE Rotol Airscrew Co., the British firm of which Rolls Royce and the Bristol Aeroplane Co. are the parent companies, has for some time past been in full production on constant speed propellers for trainer airplanes, and has recently produced a new type that offers advantages not hitherto available in the training of pilots. It has two wood blades and combines constant speed with full feathering, hydraulic operation and a weight of only 110 lb with spinner.

Pilots on advanced training machines have had to go through their "cockpit drill" with dummy controls for propellers having variable pitch in imagination only. The obvious drawbacks of this system of instruction as a preliminary to experience on operational types of airplanes have led to the introduction of the new Rotol propeller. With this available, pupil pilots on two-engined aircraft such as the Oxford and the Anson (trainer machines extensively used in England) will be able henceforth to gain practical experience of the effects of feathering and to master the technique of flying multi-engined aircraft with one engine stopped and its propeller feathered, which is vastly different from handling a machine with one engine throttled back.



Cutaway view of Rotol constant speed, full feathering propeller for trainer aircraft.



TODAY it may be an anti-tank gun, stripped for check-up... tomorrow, the still-warm "heart" of a fighter plane. So it goes. Fighting equipment gets tough treatment in modern warfare. So the need for frequent servicing and constant parts replacement is understandable.

But there is one vital part which maintenance men seldom have to touch, although they notice it often enough. The Torrington Needle Bearing, "changed over" to production-for-war, is again demonstrating its efficiency—and adaptability—in applications where its unique advantages mean more today than ever.

Its efficient system of lubrication, for example, which requires only occasional oiling, is reducing the need for maintenance attention or replacement. Its high capacity assures long bearing life, even in continuous operation under heavy loads.

Every feature of the Needle Bearing, significantly, is filling some important wartime need. Its small size is saving weight and critical materials; its remarkable ease of installation is cutting assembly time; its simplified design is eliminating extra parts and assembly steps, with low coefficient of friction assuring smooth performance.

When Victory may hang on the amount of time it takes to service fighting equipment, it is not surprising that maintenance men these days are finding Torrington Needle Bearings in more and more of America's war materiel.

IF YOU HAVE A PROBLEM *which the Needle Bearing might solve, Torrington engineers can be of valuable assistance in adapting its advantages to your needs. You are welcome to their experience, as well as the information on Needle Bearing capacities and sizes in Catalog No. 107.*

LET'S GO! U.S.A. KEEP 'EM FLYING

THE TORRINGTON COMPANY
TORRINGTON, CONN., U. S. A. • *Established 1866*
Makers of Needle and Ball Bearings
New York · Boston · Philadelphia · Detroit
Cleveland · Seattle · Chicago · Los Angeles
San Francisco · Toronto · London, England

TORRINGTON NEEDLE BEARING

Every feature fills a wartime need

New Production Equipment

Westinghouse Riveting Gun for Airplane Assembly.

MODIFICATIONS of electric iron thermostats and electric range heating elements are used in the new heating "guns" now being manufactured by Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Shaped somewhat like a submachine gun, this new tool is intended to heat du Pont rivets which contain a small explosive charge in their shank end. The heat sets off the charge within two to six seconds, and the force of the explosion expands the shank to a barrel-shaped closing head.

The thermostat is installed in the cord circuit, and accurate heat control enables the operator to utilize the maximum strength of the rivet.

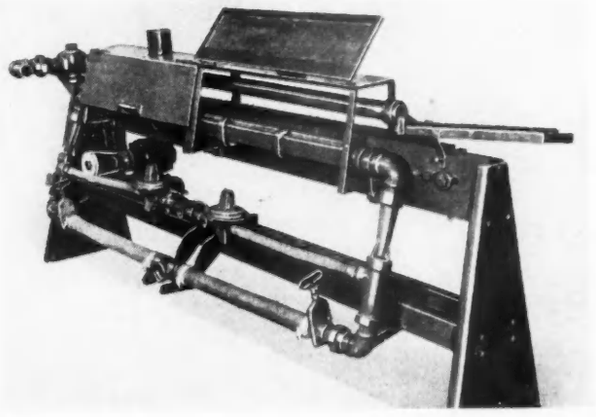
A NEW portable coolant system using a centrifugal pump, designed to deliver controlled coolant flow from 10 to 1000 gallons per hour, has been announced by Gray-Mills Co., Chicago, Illinois.

Designated Model G-10A, the new unit provides large coolant volume and high flushing capacity, making it particularly applicable for multiple spindle and deep drilling work, drill press installations, large cut-off machines, large grinders, large milling machines, large turret lathes, and as a stand-by for central systems.

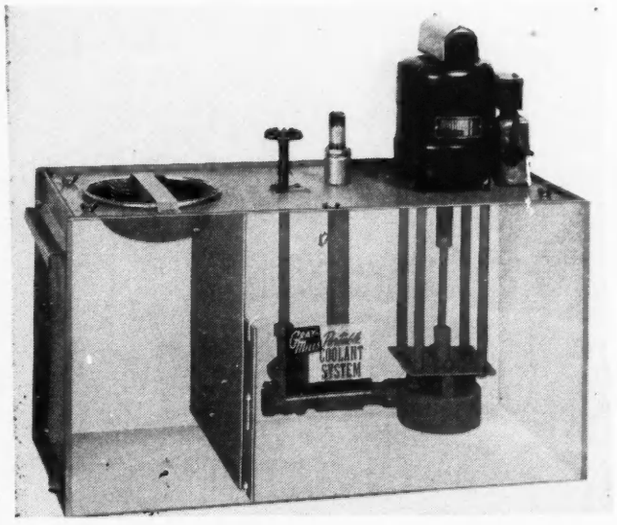
The centrifugal pump is a high stress casting, with sleeve bearings. Intake orifice is 1¼ inches; discharge 1 inch. Both 1- and 3-phase ¼-horsepower motors, 110/220 or 220/440 volts respectively, are available. The tank, of 40-gallon capacity, is 16 inches deep, 16 inches wide, and 36 inches long. Double baffle plate provides forced settling, and a separate filter screen in the tank cover is easily removed for cleaning. Tank finish is corrosion resistant. Flow control valve is easily accessible.

THE use of steel for cartridge cases has created a demand for machines to produce a uniform anneal at and near the mouth of the cases to facilitate the tapering and crimping operations. The Morrison Engineering Corporation, Cleveland, Ohio, has brought out a gas fired machine, of the continuous conveyor type, designed to achieve the desired results. Two models are available, the smaller one for 20 mm and 50 caliber cartridge cases, and the larger one for all larger sizes. The machine for small size cases is a straight line type while the larger one is a modified dial type having a conveyor chain which carries rotating work spindles provided with fixtures suited to the size of the cartridge cases being annealed. In the larger machine, the cases rotate as they pass in front of the burners, which are of the blast line type with adjustments to provide compensation for various gases and operating conditions. All controls, including proportional mixers and zero governors,

(*Turn to page* 80, *please*)

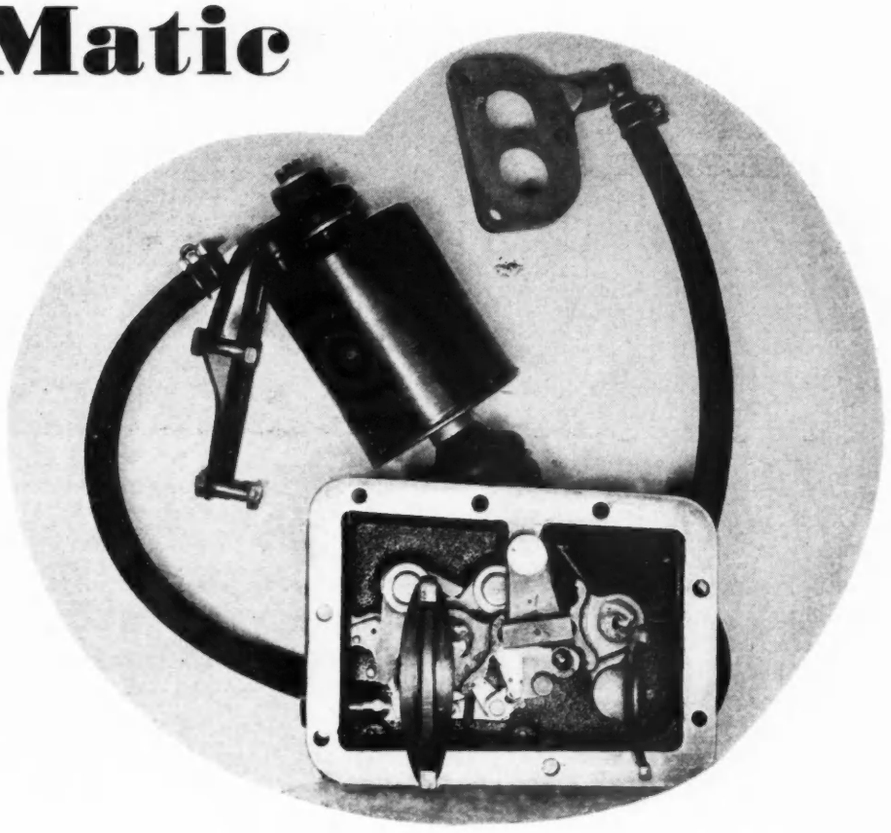


The Morrison Annealing Machine for 20 mm. and .50 caliber cartridge cases.



Gray-Mills portable coolant system.

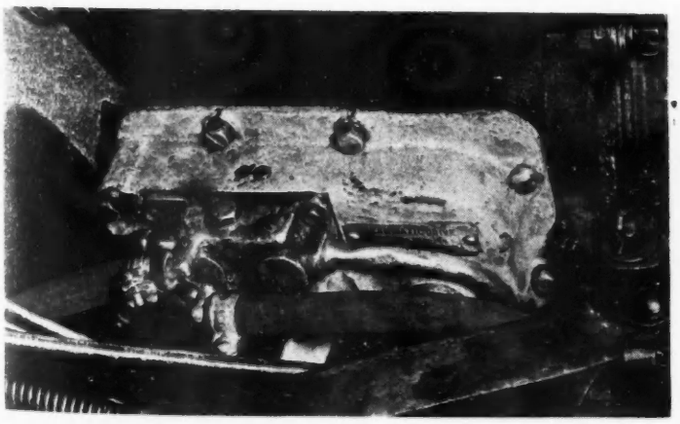
Gear-Matic Drive



Showing two units of the Gear-Matic Drive.

A NEW semi-automatic transmission control has been announced by its inventor, Glenn T. Randol, of St. Louis, Mo. It has been installed in a late model Ford passenger car and has been driven for several thousand miles. It is known as the Gear-Matic Drive and is claimed to facilitate control, reduce wear and tear on transmission parts, and to add to the safety of operation. The equipment can be readily installed on any modern passenger car with the gear shift lever mounted on the steering column underneath the steering wheel. Mr. Randol thinks it would be of advantage also on Jeeps and similar military vehicles.

There are four positions for the shift lever, viz., Neutral, Lo, Hi and Reverse. When the car is parked the shift lever always should be in the Neutral position. Under all normal conditions the car can be started in second gear. Therefore, after depressing the clutch pedal the driver shifts directly from Neutral to Hi, and when he then releases the pedal the car is started and accelerated in intermediate gear. After a moderate speed has been attained the driver once more depresses the clutch pedal, and the gear thereupon shifts automatically into high. Thereafter another depression of the clutch pedal results in a shift from high into intermediate, and the next one in a shift in the opposite direction, without manipulation of the shift lever. The inventor asserts that approximately 80 per cent of all driving is done in these two gears, and that as long as the car is being driven in either of these gears, the driver never needs to remove his hands from the steering wheel, upon which the claim for increased safety is based. Low and reverse speeds are obtained by means of the shift lever in the usual manner.

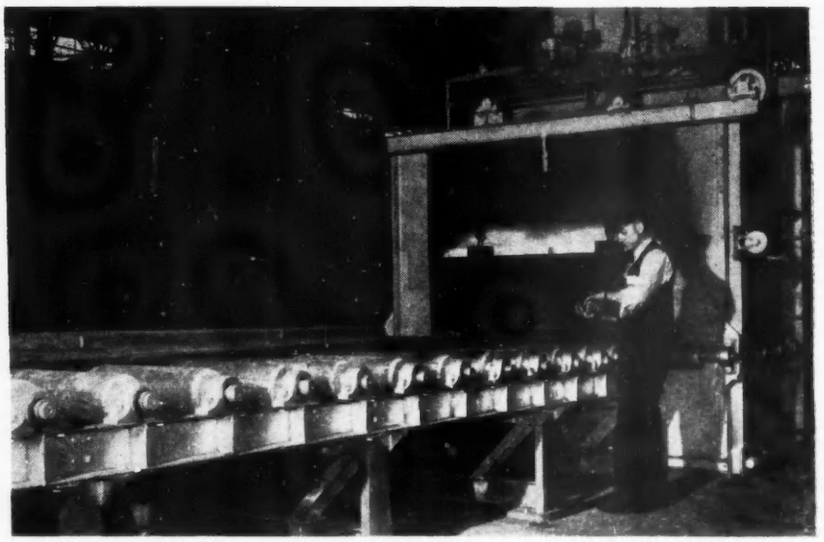


Gear-Matic Drive installed on transmission of Ford passenger car.

The Gear-Matic Drive equipment consists of four units, as follows: (1) The indicator bracket and associated selector lever, which are mounted on the steering column below the vehicle; (2) the Gear-Matic unit, which is mounted on the transmission housing and replaces the cover plate of same; (3) a distributing-arm actuating assembly which is mounted on the clutch-release shaft, and (4) the vacuum-power cylinder which is mounted adjacent to the Gear-Matic unit on the transmission housing.

Ford Engineers Develop New Method for

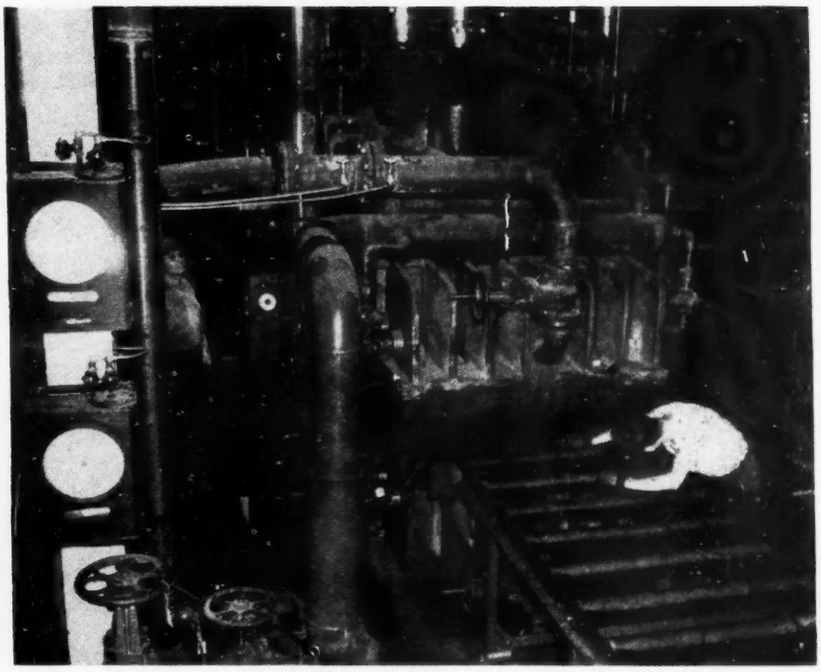
Straightening Armor Plate



Entrance to first chamber of continuous heat-treat furnace at the new Ford armor plate plant.

A NEW "quenching" method, now being used at the Ford armor plate plant for straightening armor plate, speeds the final stages of its production and also eliminates large and costly straightening machines. The process, which was developed by Ford engineers and is applied to the metal immediately after it has been put through the heat-treat furnace where the armor is fired to shell-resisting hardness, substitutes water-cooled dies for water tanks, sprays and straightening machines as used in steel plants.

Although the technique has been employed in the past to flatten much smaller sections of furnace-hot metal, its present application to greater areas and thicknesses for Army tanks was first regarded by steel men as an experiment. Virtually every rolling mill in the country, Ford engineers pointed out, cools furnace-hot armor plate by sprays or immersions. This rapid cooling system, while it reduces temperatures in a brief period, results invariably in the warping or buckling of the armor plate. Because of this inevitable warping of the armor plate, every mill must use huge straighteners to press the plate to the necessary flatness. This operation, they state, takes at least two hours to complete.



This huge hydraulic press in the Ford armor plate plant, with its two broad dies capped by water-cooled platens, straightens and cools armor plate after it has rolled out of heat-treat furnace. The photo shows worker adjusting cable so as to be in readiness when furnace discharges plate. Use of cable is temporary.

The Ford set-up consists of a water-cooled die-press that is connected by a roller track to a continuous heat-treat furnace. In one operation the straightening and cooling job is done in three to eight minutes, depending upon the length, width and thickness of the armor plate pressed by the dies. Once it is discharged from the furnace, in which the strip of steel is heated from two to four hours, the blast-red armor plate automatically is pushed between the huge water-cooled dies, which immediately takes the plate in a grip of 2500 tons pressure.

Features which made the dies feasible as water-cooled plate straighteners are two platens, one of which is attached to the upper and lower jaws of the broad press. These platens are hollow and are fed cold streams of water during the period the furnace-red steel is sandwiched between them.

FRIDAY

motor failure

MONDAY

WAR PRODUCTION AS USUAL

125 HP FOUNDRY MOTOR FAILED FRIDAY, 4 AM. EMERGENCY CALL TO NEAREST WESTINGHOUSE MANUFACTURING & REPAIR PLANT STARTED WORK IMMEDIATELY. NEW COILS FORMED, INSULATED, TREATED, STATOR STRIPPED, REWOUND, DIPPED, BAKED, TESTED. DELIVERED MONDAY, 2 PM, TO WAR PLANT. BAD NEWS FOR AMERICA'S ENEMIES.

Westinghouse
MANUFACTURING AND REPAIR

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IF THE EQUIPMENT NEEDING MAINTENANCE OR REPAIR IS VITAL TO THE WAR EFFORT ...PHONE OR WIRE THE NEAREST WESTINGHOUSE "M & R" PLANT FOR

EMERGENCY SERVICE

33 PLANTS . . . ONE NEAR YOU!

U. S. Automobile Manufacturers Outdo German Tank Builders

Army Is Endeavoring to Concentrate on Single Type of Tank Engine in Each Theatre of War to Simplify Upkeep

U. S. tanks are superior to German tanks of comparable size. Such is the expert opinion of Brig.-Gen. John K. Christmas, assistant chief of the Tank-Automotive Center at Detroit, based on reports from the Libyan war theater and other fighting fronts. This opinion is confirmed by Lieut.-Col. Joseph M. Colby, chief of the development section of the Tank-Automotive Center who has just returned from a tour of the battle fronts where he received first-hand information on the performance of the U. S. land juggernauts. Points that give U. S. tanks the edge over their Nazi counterparts are greater firepower, more mobility, better armor protection and greater reliability.

Standardization on a single type of engine for U. S. tanks might be desirable from a maintenance and spare parts standpoint but there are other factors to be considered. A tank engine operating under the dry heat and dust conditions of the Libyan desert might not be the best powerplant for the cold wind-swept steppes of northern Russia or for use in the humid jungles of New Guinea. The fuel supply available also may dictate the type of tank engine to be employed. At present the U. S. Army is endeavoring to concentrate on a single type of tank engine in each theater of war in order to simplify upkeep and spare parts problems.

Three types of power plants are currently being installed in U. S. tanks. These are the air-cooled gasoline engine, like the Wright Whirlwind made by Continental Motors Corp.; the liquid-cooled gasoline engine, like the Wright cooled gasoline engine, such as the Chrysler multi-bank and the Ford engines, and the Diesel engine made by General Motors Diesel. It appears that one of the first two types may get the nod as the ideal power plant for tank operation. The Diesel engine has not yet gained wide favor commercially in truck operation and has never been used except experimentally in passenger cars, so these factors may sway the final decision.

Based on the experience in Libya, Col. Colby is inclined to favor the air-cooled gasoline engine. Reasons for this are that it operates better in temperature extremes, keeps maintenance and repair at a minimum, is less vulnerable to enemy gunfire and fits tank engineering better.

(*Turn to page 70, please*)

Canadian War Production Shows Great Increase

Canada, which recently became a member of the Combined Production and Resources Board, along with the U. S. and Great Britain, has received war orders totaling $5 billion since July 14, 1939, a figure in excess of the nation's average annual peace-time industrial output. U. S. war products now manufactured in Canada include M-4 tanks, Curtiss dive bombers, Consolidated PBY flying boats, anti-aircraft and anti-tank guns, aircraft instruments, communications equipment, shells and bombs. As of Oct. 1, $900,000,000 in war orders had been placed by the U. S. in Canada. Half of the Dominion's machine tool production is being shipped to the U. S. Canada's 1942 war production is estimated at $2½ billion.

Aircraft production in Canada is approximately 400 planes per month, according to C. D. Howe, minister of munitions and supply, who becomes a member of the Combined Production and Resources Board with Donald M. Nelson, and Oliver Lyttelton, of Great Britain. This has increased from an output of 100 planes in all of 1939. By the end of 1942 Canada will have produced 500,000 military vehicles. Canada is producing Hurricane fighter planes at the Fort William (Ont.) Canada Car Plant, De Havilland Mosquito fighter-bombers made partly of plywood, and is preparing to make four-engine Lancaster bombers.

The Lancaster bombers will be produced in the former plant of the National Steel Car Co., at Malton, Ont., near Toronto, which has been expropriated by the government. It will be operated as a crown company known as Victory Aircraft, Ltd., and will be headed by J. P. Bickell, mining executive who has studied aircraft production methods in England. A $50,000,000 order for these bombers has been placed.

Other British war items being made in Canada include Valentine tanks, Lee Enfield rifles, Browning machine guns, depth charges and anti-tank mines.

Strikes Continue to Hinder Production in Vital War Plants

WLB Regional Directors to Select Advisory Boards to Assist in Administration of Stabilization Program

Two plants of the Nash-Kelvinator Corp. at Lansing engaged in the production of vitally needed aircraft propellers were shut down for two days in mid-November in a dispute between members of the UAW-CIO and the company over the conduct of a foreman and his assistant in the blade assembly department. Three hundred workers in the department refused to work with the two supervisory employes and ejected them from the department when they returned to the job after two days away. The plant manager then ordered the power turned off in the department and the men went home. Other departments also were forced to close down when production in this key department ceased.

John Haruska, president of local 13, accused the company of a lockout and said his men were ready to report back for work. He said the foreman and his assistant were non-cooperative on grievances and that a 30-day "probationary period" for the two men had ended Oct. 31 after the union protested their presence in the department. Following intervention of state and federal mediators, an agreement finally was reached by which the men returned to work and the foreman and his aide resumed their positions. However, a number of the company labor-relations staff was assigned to the department to handle all grievances and the two supervisory men upon whom the dispute centered were to devote their attention only to the mechanical aspects of the department.

A proposal of Chrysler Corp. that negotiations over revision of the corporation's contract with the UAW-

(*Turn to page 74, please*)

To answer the widespread, increasing demand for faster-driving Phillips Recessed Head Screws, 19 prominent screw manufacturers offer their tremendous manufacturing capacity and nationwide distribution to assure prompt delivery.

Aircraft and automotive manufacturers find this *national* capacity a real protection to profits and production.

Over 200 Phillips Fastening Engineers—to Help You Get the Most from Phillips Screws — Save Man-Power and Materials.

While simply changing from slotted to Phillips Screws has often speeded assembly 50%, many firms have obtained maximum results with the help of sales engineers specializing in Phillips products. Their experience is at your service — to save man-hours — to speed job-training programs — to step up production by permitting power driving, eliminating refinishing costs, fumbled and lost screws, damaging burrs.

"Remember—it's not the price of the screws that counts . . . it's the cost of using them."

Speed product deliveries by saving assembly time

Specify Phillips and Save 50%

PHILLIPS RECESSED HEAD SCREWS

WOOD SCREWS • MACHINE SCREWS • SHEET METAL SCREWS • STOVE BOLTS
SPECIAL THREAD-CUTTING SCREWS • SCREWS WITH LOCK WASHERS

19 SOURCES OF SUPPLY

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N.H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N.Y.
Pawtucket Screw Co., Pawtucket, R.I.
Pheoll Manufacturing Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N.Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N.H.

Makers of Open-Hearth Steel Using Greater Percentage of Pig Iron

Scrap Deficiencies Being Made Up by Increased Output of Pig Iron; Use of Bessemer Steel Urged Where Possible

By W. C. HIRSCH

In view of the approaching close of the iron ore navigation season it is pointed out that condition of the Great Lakes during winter is not the only cause of impairing the movement of ore to furnaces; freezing of the ore during winter weather in handling is considered by many fully as much, if not more of a break than interruption of navigation. This difficulty is almost certain to be encountered even though lake navigation can be kept open longer than usual. It assumes more than ordinary importance at this time because of the increased supply of pig iron that is needed to make up for whatever shortcoming may develop in scrap iron.

According to a recent announcement by the American Iron & Steel Institute, output of pig iron and ferroalloys during the current year's first ten months came within a few hundred thousand tons of 50,000,000 tons. On this basis an output of 60,000,000 tons is expected in 1942, topping the 1941 record by approximately 4,500,000 tons. According to an analysis by the American Iron & Steel Institute, makers of open-hearth steel are using this year 580 tons of pig iron for every thousand tons of steel, compared with an average of 557 tons in 1941, indicating a rather sharp contraction in the use of scrap. Under prevailing conditions, these figures prove reassuring because they indicate that scrap supply deficiencies can be and are being progressively made up for by increased pig iron output. Steel consumers are also urged by the War Production Board's Iron and Steel Branch to use Bessemer steel in all applications where the close control of properties obtainable by the open hearth process is not of paramount importance. The use of Bessemer steel, which in the early years of this century had a dominant position in the market, has fallen off sharply compared with that period and with it there developed a corresponding shrinkage in the aggregate capacity of Bessemer producers. Yet enough of this remains to make its full time employment desirable, thereby lightening, even though slightly, the pressure on basic open-hearth process mills. Current steel output continues at a high rate, surprisingly little time having to be lost because of necessary furnace repairs. So far, however, no one in the steel market is taking seriously the comment of one Washington official that "steel mills will be looking for business by the first of the year." Quite likely it is that further progress will be made in bringing production and requirements into sufficient balance to lessen tension and smooth the functioning of manpower as well as equipment.

A recent report of the Metals Reserve Company, dealing with the record of the recently opened tin smelter in Texas, indicates that the tin problem gives cause for less worry today than do many other strategic materials. What with the extreme care that is being taken to restrict the metal's use to essential needs; the recovery of as much tin as possible from disused tin plate; and the activities at the new smelter there is every reason for confidence in our being able to supply our needs for the duration. A small quantity of tin concentrates is reported to have been received at the smelter from North Carolina. This does not mean that a commercially promising deposit of tin has been uncovered in the Tar Heel State, but that the possibility of there being such a deposit located there is now being investigated. The presence of cassiterite in the Carolinas has long been known to geologists, but as a mineralogical curiosity.

An Engine Stand That Meets Every Requirement of Full-Speed, Full-Time Production

● Designed for use with interchangeable mounting plates for radial engines, this stand has an entirely enclosed gear drive and adjustable arm brackets which make it easy to obtain the center of gravity on a wide range of engines. Speeds inspection, servicing and overhauling. Equipped with friction floor stop, removable oil pan, steel ball bearing casters. Write or wire for descriptive literature on our complete line of stands for aeroplane and tank engines.

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COLUMBUS, INDIANA, U. S. A.

Rang at 4:30 a. m.

INDUSTRIAL production has travelled far since the days of the "Bell Card" but again the time comes for heroic effort as America, "Arsenal of Democracy," supplies not only its own war needs, but those of half the world in this time of struggle.

No need now for "daylight saving" plans as brilliant, modern lighting speeds production for full twenty-four hours. But there is still need, and there always will be need, for pioneering ideas in industry.

For ideas as new and as sound as those that vitalized this neighborhood years ago Industry can look to Jones & Lamson . . . ideas that will help you in today's emergency and in the hard times that lie ahead.

Inquiries from large or small companies all receive the careful, detailed study of our engineers.

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Manufacturers of Ram & Saddle Type Universal Turret Lathes . . . Fay Automatic Lathes . . . Automatic Thread Grinding Machines . . . Comparators . . . Automatic Opening Threading Dies and Chasers

Springfield, Vermont

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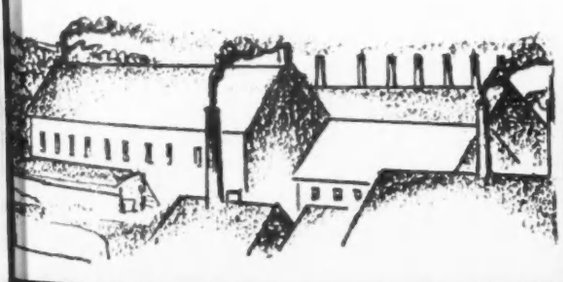

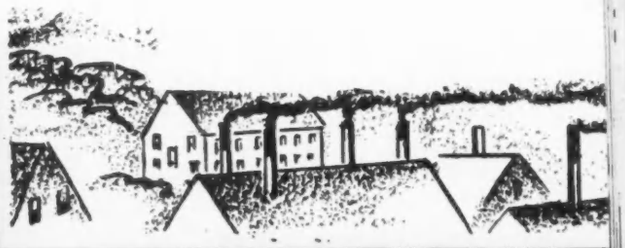

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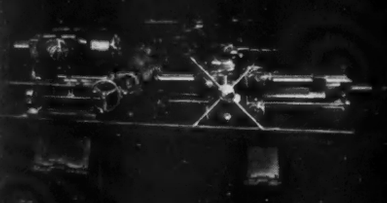


SADDLE TYPE
UNIVERSAL TURRET LATHE

RAM TYPE
UNIVERSAL TURRET LATHE

Fedden Leaves Bristol

Sir A. H. R. Fedden has relinquished his executive position as chief engineer of the Aero Engine Division of the Bristol Aeroplane Co. The executive control of the company's engine design and development will be entrusted to Norman Rowbotham, for many years manager of the engine production plants.

In a statement issued by Fedden he said that he did not want his friends to think that he had "quit" in the middle of the war and that, in actual fact, he had been dismissed from his post.

For 22 years the names of Fedden and Bristol have been considered as one, for during that time Fedden has been responsible for the development of all of the many highly successful Bristol radial engines, including the latest types, such as the 14 cylinder sleeve valve Hercules, which are said to provide about half the power load of the Royal Air Force. Four times the Bristol engines have taken the World's height record; they supplied power for the World's distance record, which still stands.

BUY

DEFENSE BONDS AND STAMPS

. . . AND LONGER LASTING AETNA BALL BEARINGS

☆ Remember the wiser you buy the more you help to conserve labor and materials that are indispensable to a nation at war—to *VICTORY!*

Long-lived, dependable AETNA PRODUCTS mean less frequent replacements, increased production and extended machine life. You save for yourself, for your country.

AETNA BALL BEARING MFG. CO.

4600 Schubert Ave., Chicago

Thrust Ball Bearings (Standard and Special) . . . Angular Contact Ball Bearings . . . Roller Bearings (Special) . . . Ball Retainers . . . Hardened and Ground Washers

CENSORED

An exclusive feature prepared by M. W. Bourdon, special correspondent of Automotive *and* Aviation Industries in Great Britain.

By arrangement between the Motor Agents' Association and the Ministry of Supply, the latter will pay the Association £2 per ton for all scrap rubber collected by garage proprietors from the public. The total amount thus received by the Association will be given to hospitals and war-time charities without any deduction for expenses or payments to garages. The Ministry will provide transport from garages to dumps in various parts of the country.

To ensure the preservation of cars that have attained historic interest, the Veteran Car Club of Great Britain will purchase such cars as and when they become available at a fair price. A fund for the purpose is to be secured from members as guarantors of sums up to £25. Members will be able to buy the veteran cars from the club under agreement whereby, if there is desire to re-sell, the club shall have first refusal to repurchase.

The system of interchange of machine tools among munitions manufacturers who have tools not in use and those requiring such tools is to be fostered in the automobile repairing industry. This is one result of the call for concentration of industry in the retail motor trade in order to conserve equipment and labor. Another step now being taken with the same object is to form area committees of the Motor Agents' Association to prevent, as at present, some repair shops being short of work within the capacity of their equipment and staff while others in the same district constantly have more work of national importance offered them than they can deal with.

Trade unions have presented to employers a claim for the adjustment and improvement of wage rates for women in the engineering industry. They suggest a minimum rate equal to 85 per cent of the rate applying to unskilled men, with 90 per cent of the men's rate where semi-skilled work is done and the full rate paid to men where women undertake the setting-up and working of machine tools.

So-called "workers' courts" (i.e. committees representing management and employees) that are being set up in an increasing number of manufacturing plants to deal with delinquences on the part of workers, are also being formed by bus operating companies, chiefly to adjudicate in cases where absenteeism and frequent lateness for work is reported. A high incidence of absenteeism occurs particularly among conductresses, and in some bus services up to 20 per cent additional personnel to counteract it has had to be kept on the payroll.

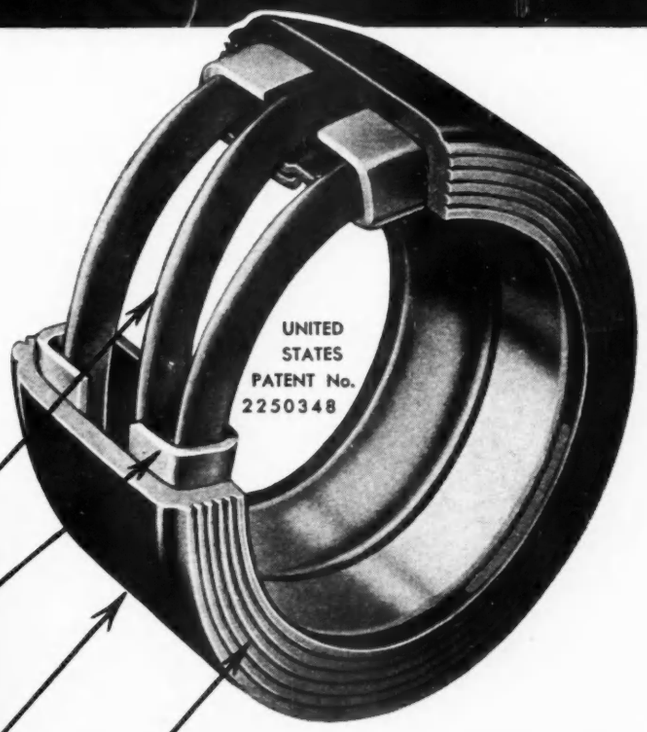
As there will be very little anti-freeze available this winter relative to the quantity required, "The Motor" (London) suggests that soapy water might serve and asks readers who have tried it to relate their experiences. Soap is severely rationed, but soapy water from the domestic wash-tub should answer, it is also suggested.

At a meeting convened by the Ministry of Supply, Rubber Control, and the Ministry of War Transport, Major Eastwood, Regional Transport Commissioner, spoke of the seriousness of the tire position and said that if the country's rubber consumption continued at the present rate Britain might be faced with a complete standstill of road transport services.

AQUA-TITE

The SCHWITZER-CUMMINS PUMP SEAL WITH ALL METAL PARTS ENCLOSED AND PROTECTED AGAINST CORROSION

● Millions of Schwitzer-Cummins AQUA-TITE Seals are operating successfully in the pumps of automobiles, trucks, tractors, air craft engines, combat vehicles, etc.; in all types of installations using every kind of coolant where the sealing must be perfect and uninterrupted service and long life of the seal are demanded. Many superior features account for its world-wide use and acceptance.



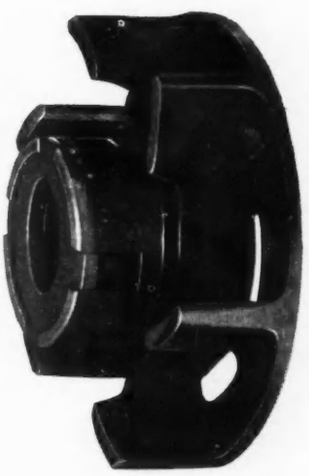
THE SPRING—Low rate compression spring **completely enclosed in rubber housing** with tension uniformly applied through METAL FERRULES which form continuous seats on the rubber flanges protecting them from damage.

SYNTHETIC RUBBER HOUSING—Available in different compositions that will resist attack from any anti-freeze solution.

SEALING FLANGES—Designed to flex and adjust themselves to any wear of the sealing faces or out of line condition.

SCHWITZER-CUMMINS are the pioneers in the development of automatic seals for pumps and for 14 years have been continuously engaged in the manufacture and engineering of this product. This wide experience is responsible for the use and acceptance of AQUA-TITE Seals all over the world. They have an unusual range of adaptability and our engineering experience is available to anyone with a tough problem of sealing-in any kind of liquid.

Available in **MANY DIFFERENT MODELS and SIZES** . . . all compact, complete, simple and ready to install in either pump housings or the impeller.



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THE MARK OF MERIT AQUA-TITE

SCHWITZER-CUMMINS COMPANY

INDIANAPOLIS, INDIANA, U. S. A.

MEN . . . . . .

Harry Woodhead, president of Consolidated Aircraft Corp., has been elected president of Vultee Aircraft, Inc., succeeding **R. W. Millar,** who resigned recently. **I. M. Laddon,** vice-president and general manager of Consoldated, has been elected a vice-president of Vultee. Both will continue in their present capacities with Consolidated, whose stock is controlled by Vultee.

Cyrus Ching, vice-president of U. S. Rubber Co., has been appointed a member of the War Labor Board representing employers, succeeding **E. J. McMillan,** resigned

A. B. Quinton, Jr., chief of the Detroit Ordnance District, has been elevated from colonel to the rank of brigadier-general by recommendation of the president.

Elmer E. Stuart, formerly auditor, has been named assistant treasurer of Thompson Products, Inc.

Charles Gale, formerly editor of The Sportsman Pilot, has been appointed public relations counsel for Fairchild Airplane & Engine Co.

W. O. Leonard, formerly vice-president, has been named president of Wilson Foundry and Machine Co., Pontiac, Mich. He succeeds his father, H. L. Leonard, who becomes chairman of the board.

Merrill C. Meigs has resigned as deputy chief of aircraft production for WPB, effective Nov. 15, to return to his former position with the Hearst newspapers.

Montague A. Clark, director of industrial and public relations for the U. S. Rubber Co. at Detroit, has taken a leave of absence to become Michigan director of the War Manpower Commission. He will direct and coordinate the work of all government agencies in the field of manpower and serve as liaison between the government and management and labor. A Michigan advistory committee has been appointed composed of the following: Management representatives—**John L. Lovett,** Michigan Mfrs. Ass'n.; **Frank Rising,** Automotive Parts & Equipment Mfrs., Inc.; **Willis Hall,** Detroit Board of Commerce; **William J. Cronin,** Automotive Council for War Production; labor representatives — **August Scholle,** Michigan CIO; **Victor Reuther,** UAW-CIO; **George W. Dean,** Michigan AFL; **Frank X. Martel,** Detroit & Wayne County AFL.

Clarence M. Bolds has been appointed head of the labor production division in the Detroit regional office of WPB. He has been on leave of absence for 10 months from the Kelsey-Hayes Wheel Co., serving as an advisor to the WPB labor division in Washington.

Harold Shepard, formerly manager of the Detroit branch, has been made manager of the Chicago branch of Cadillac Motor Car Division of G. M. He will succeed Victor C. P. Dreiske, now a lieutenant-commander in the U. S. Navy. J. E. Robert, sales manager of the Detroit branch since 1934, will succeed Shepard as Detroit manager.

Bruce Gregory, formerly sales manager, has been named vice president in charge of sales and a member of the board of directors of Thornton Tandem Co., Detroit.

Capt. Frank C. Silvey, formerly supervisor of parts warehousing and distribution for the Chevrolet Motor Division of General Motors, has been appointed chief of the supply division of the Fort Wayne Ordnance Motor Supply Depot, Detroit.

Grace & Bement, Inc., Detroit, has been awarded the advertising account for aircraft parts and assemblies of the Briggs Mfg. Co.

Clarence W. Avery, president of Murray Corp. of America, has been elected a Class B director of the Federal Reserve Bank of Chicago. **Max W. Babb,** chairman of the board of Allis-Chalmers Mfg. Co., was re-elected a Class B director.

Harold Boeschenstein, president and general manager of the Owens-Corning Fiberglass Corp., Toledo, has been appointed director of the Controlled Materials Plan Division and chairman of the Controlled Materials Board of WPB. **W. C. Skuce,** supervisor of materials procurement, priorities and inventory control for General Electric Co., has been named assistant director. Working in close cooperation with Boeschenstein and Skuce will be **Hiland G. Batcheller, Arthur H. Bunker** and **Harry O. King,** directors of the three controlled materials divisions—steel, aluminum and copper. The CMP division will operate under **J. A. Krug,** deputy director general for distribution of WPB. Within the division will be the Scheduling Methods Branch, the Instruction, Inquiry and Service Branch and an Operations Branch.

Earl B. Busenberg, chief chemist of the Philadelphia Rubber Works Co., reclaim division of the B. F. Goodrich Co., has been loaned to the government to serve on the staff of technical consultant asisting **William M. Jeffers,** U. S. rubber director.

The American Bosch Corp. announces the appointment of **Robert C. Mathewson** as assistant manager of the company's branch

(*Turn to page 66, please*)

CAST ALUMINUM FITTINGS

YES! NIBCO fittings of cast aluminum . . . accurately machined to absolute uniformity . . . are moving at ever increasing speed into the aircraft plants where they're needed . . . delivered on time . . . meeting the most rigid standards and the stiffest inspection. The same engineering genius which developed the NIBCO Wrot Fitting formed in one step from a straight tube of copper, is meeting in *outstanding* fashion, the new problems which the war has created. Our facilities are 100% devoted to War work now . . . but when the new day comes . . . you'll need us and we'll need you.

NORTHERN INDIANA BRASS CO.
ELKHART, INDIANA
VALVES AND FITTINGS SINCE 1904

CALENDAR

Conventions and Meetings

Amer. Society of Mechanical Engrs. New York City, Annual Mtg. Nov. 30-Dec. 4
Highway Research Board, St. Louis Mo. ..... Dec. 2-4
SAE Air-Cargo Engineering Mtg., Chicago ..... Dec. 8-9
SAE War Engineering-Production Mtg. Detroit ..... Jan. 11-15

"Too Little-Too Late!"

Two things can lick "too little—too late!" 1. Greater output. 2. Faster production. And both go hand in hand. For if efficiency can be improved and rate of operation increased, the total of perfect parts produced will climb.

This isn't a new problem — not to Union Drawn metallurgists and engineers. Greater efficiency and higher output *plus* finer quality and lower cost per finished steel part have constituted the problem uppermost in their minds and always first on their list of jobs to be done for more than half a century.

What have they accomplished?

ANSWER No. 1—The uniformly high machinability of Republic Union Cold Drawn Steels which is helping to lick "too little — too late" today. The countless times during the last 50 years when machinability—the all-important factor in the mass production of duplicate steel parts — has been increased. The reduction of tool-wearing abrasives to today's remarkably low point. The smooth, bright machined surface now obtainable. The maintenance of physical properties and heat-treating qualities at high levels. The fastest-machining Bessemer screw steel made today — UNION SUPERCUT.

ANSWER No. 2—The Union Drawn Steel Handbook, now in the hands of thousands of screw machine operators. Part of Union Drawn's job of helping to lick "too little—too late" consists of producing every possible pound of the most machinable steel in needed analyses. The other part — just as important — is that of helping steel parts producers obtain the highest possible rate of production of perfect parts at lowest cost.

The Union Drawn Steel Handbook, first published in 1934, was designed to do just that—to provide automatic screw machine operators with helpful facts and figures obtained from countless tests and unequalled experience in laboratory and shop. The heavy demand for this handbook has necessitated the printing of four new editions — each revised and brought up to date with new information, each substantially enlarged with additional pages of helpful data. The first edition contained 30 pages — the new No. 42 edition contains 84 pages, giving steel analyses and their A.I.S.I. and S.A.E. numbers, physical properties, heat treatment, recommended speeds and feeds for standard tools, spindle speeds, weight and area tables, stock estimating tables and other valuable helps.

Are you taking full advantage of the uniform machinability of Republic Union Cold Drawn Steels? Are you using your Union Drawn Handbook and the gold mine of machining information it offers you? Both will help you lick "too little — too late." And, if for some reason you cannot find the answer to a troublesome machining or heat treating problem, write us, quite likely we can help.

REPUBLIC STEEL CORPORATION
Union Drawn Steel Division
Sales Offices · Massillon, Ohio
GENERAL OFFICES · CLEVELAND, OHIO
Berger Manufacturing Division • Culvert Division
Niles Steel Products Division • Steel and Tubes Division
Truscon Steel Company
Export Department: Chrysler Building, New York, N. Y.

Union Drawn Steels

Free-Machining Bessemer, Open-Hearth and Electric Furnace Steels
•
Union Cold Drawn Special Sections
•
Union Cold Drawn and Ground Rounds; Turned and Polished Rounds; and Turned, Ground and Polished Rounds (Union Precision Shafting).

MEN

(*Continued from page 62*)

office at Chicago, in charge of field engineering.

Ahlberg Bearing Co. has announced the appointment of **Charles Nelson, Jr.,** to be chief engineer of the company, in charge of bearing design and development work.

Aircraft Parts Development Corp., Summit, N. J., has announced the election of **Dan C. Hungerford** as president and general manager. He was formerly vice-president and director of the Elastic Stop Nut Corp.

Harry G. Kitchin, Richmond, Ind., has been appointed chief administrative officer of the Tools and Equipment Group, Manufacturing Branch, Tank-Automotive Center of the Ordnance Dept. in Detroit.

Announcement has been made of the appointment of **W. E. Griffiths** as assistant manager of sales, Flat Rolled Products, Allegheny Ludlum Steel Corp.

D. A. MacKinnon has been made sales engineer of Hydraulic Machinery, Inc.

Harry Crump has joined Carboloy Company, Inc., as assistant to **K. R. Beardslee,** sales manager. Mr. Crump was formerly associated with General Electric Co.

The appointment of **Harry D. Beutlich** as director of personnel and industrial relations for Willys-Overland Motors, has been announced by **Joseph W. Fraser,** president of the company.

C. E. Wooliever, personnel director of the Chicago aircraft engine division of Buick has been named general chairman of the Automotive and Machine Shop Section of the National Safety Council.

A. H. Philpot, metallurgical engineer, has been appointed by Copperweld Steel Co., Warren, Ohio, to manage its Washington District office.

David R. Osborne, sales training director of the Studebaker Corp., has been elected president of the National Society of Sales Training Executives. Mr. Osborne, succeeds **R. C. Cathcard,** Educational Director of the Texas Co.

G. E. Read has been appointed regional manager of the Philadelphia territory for Studebaker. He succeeds **W. K. Erdman,** who resigned recently to accept a major's commission in the Army of the United States.

Business in Brief

***Written by the Guaranty Trust Co., New York, Exclusively for* AUTOMOTIVE AND AVIATION INDUSTRIES**

A continuing rise of general business activity is indicated. The seasonally adjusted index of *The New York Times* for the week ended Nov. 14 advanced to 135.7 per cent of the estimated normal, as compared with 131.2 a week earlier and 132.2 a year ago. The index of *The Journal of Commerce*, without seasonal adjustment, for the same period rose to 129.1 per cent of the 1927-29 average from 127.5 for the preceding week.

Department store sales during the second week of November, as reported by the Federal Reserve Board, were 13 per cent above comparable levels last year; and for 1942 thus far the corresponding gain is 11 per cent.

Railway freight loadings during the week ended Nov. 14 totaled 826,601 cars, 0.3 per cent less than the number for the week before and 6.5 per cent below that for the comparable period last year. Available ton-mile figures, however, are taken to indicate for 1942 a probable rise of more than 30 per cent above the 1941 traffic.

Electric power output increased more than seasonally in the second week of November and was 12.8 per cent greater than a year ago, as against a similar excess of 11.7 per cent a week earlier.

Crude oil production during the same period averaged 3,879,750 barrels daily, 41,350 barrels above the figure for the preceding week but 151,650 barrels less than the average output recommended by the Office of the Petroleum Coördinator.

Average daily production of bituminous coal during the second week of November was 1,850,000 tons, as compared with 1,860,000 tons in the week before and 1,968,000 tons a year ago.

Engineering construction contracts awarded in the week ended Nov. 19 dropped sharply to $100,000,000 but exceeded by 56 per cent the comparable figure last year, according to *Engineering News-Record*. For 1942 to date, the total is 62 per cent greater than the corresponding amount in 1941—with public work 90 per cent higher than a year ago, as against a drop of 52 per cent in private contracts.

Professor Fisher's index of wholesale commodity prices for the week ended Nov. 20 stood unchanged at 108.5 per cent of the 1926 average, as against 98.6 a year ago.

Member bank reserves rose $125,000,000 during the week ended Nov. 18, and estimated excess reserves increased $90,000,000 to a total of $3,490,000,000. Business loans of reporting members increased $45,000,000 in the preceding week but stood $271,000,000 below the total a year earlier.

Buy U.S.
WAR BONDS
today!
NEED MORE
Skilled HANDS
TO SPEED WAR
PRODUCTION?
A WAYNE Tube Beader beads or flares aluminum or copper tubes many times faster than it has ever been done before. Operation is semi-automatic . . . any man or woman can do the work. The skilled hands usually required for beading tubes manually can be released for more essential tasks. Already in use in leading aircraft plants.
THE WAYNE PUMP CO., FORT WAYNE, INDIANA
Wayne
TUBE BEADER

PUBLICATIONS

The second of a series of Lathe Service Bulletins, issued in the interest of more efficient war production, has just been published by the **South Bend Lathe Works.** It emphasizes the importance of proper lathe lubrication in maintaining maximum performance and accuracy. The title of the bulletin is **Oiling The Lathe.***

Faster Production With Tocco is the title of a new booklet released by **The Ohio Crankshaft Co.,** developers of the Tocco process of induction heating. The 16-page booklet describes Toco operating principles in hardening, brazing, annealing and heating metal gives and the results achieved from the use of this process.*

The Dumore Co. has just published a 36-page catalog designed to facilitate the purchase of portable precision grinders. Each grinder is illustrated and principal dimensions are given in outline drawings. Grinding quills are illustrated with each grinder and the range of work that can be handled is specified. The catalog is No. 42.*

Black Drill Co. has issued a new booklet on hardsteels in drills, reamers, etc., and containing timely facts about Hardsteel.*

Lamson Corp. has published a new booklet giving facts about **Lamson Roller Gravity Conveyors,** and telling also how the individual parts are designed and made. It shows, too, the various accessories, supports, switches, stops, etc. Gives a table on selecting conveyors for various package sizes and illustrates a few applications.*

Two new bulletins have been issued by **Hydraulic Press Mfg. Co.,** No. 4207, Presses for Process Industries and No. 34, The Hydraulic Press, complete with charts, specifications and photographs of the various types of presses made by this company.*

The Turner Brass Works has just produced an attractive two-color Wall Chart, entitled **Know Your Blow Torch.** It describes and illustrates how all parts of a blow torch are labelled and how lighting instructions and safety hints are shown in action pictures.*

The Mercury Mfg. Co. announce the publication of an informative, illustrated new catalog dealing with its approved models under the WPB Limitation Order L-112. The catalog contains the minimum of exposition and deals specifically with the factors in which a busy plant executive is interested. Included is an explanation of the procedure for ordering a truck under the above order, descriptions and specifications on the various mercury models and an explanation of the application for each type of equipment.*

A handbook of instructions on the installation and servicing of hydraulic accumulators in aircraft, with specific reference to the **Simmonds-Olaer** accumulator, has been issued by **Simmonds Aerocessories, Inc.***

Farrel-Birmingham Co., Inc., has issued a new booklet on roll and cylindrical grinders. It describes the advanced design, construction and operating advantages of the **Farrel Type TT Roll Grinder** with moving work table. The booklet is illustrated and has tables of general specifications, dimensions and weights.*

Abrasive Cutting, a new booklet which explains the development and application of abrasive cutting has just been issued by **Andrew C. Campbell Div. of American Chain & Cable Co.** It contains plenty of details, photographs and tables about the operation of abrasive cutting machines.*

A new brochure by **Fostoria Press Steel Corp.** illustrates and describes how good lighting and the near infra-red process are speeding the production of war materials used in these phases of warfare—on the land on the sea and in the air.*

*Obtainable through Editorial Dept., Automotive and Aviation Industries, Chestnut and 56th Sts., Philadelphia. In requesting any of these publications, please give date of issue, your company connection, and position.

...NOW STEPPING UP WAR DELIVERIES

1. They save the worker's time
Each nut is a self-contained easy-to-handle unit that goes on fast . . . and its self-locking action is immediate and automatic.

2. They eliminate the dangers of careless assembly
The locking element is built into the nut . . . no pins, wires, washers, or shims that can be forgotten or incorrectly applied.

3. They reduce inspection needs
With less operations and less parts to be checked . . . there's another important saving in man-hours.

There are more Elastic Stop Nuts on America's airplanes, tanks, guns, Naval vessels, and production equipment, than all other lock nuts combined.

» *Write for folder explaining fully the Elastic Stop principle*

ELASTIC STOP NUT CORPORATION
2339 VAUXHALL ROAD · UNION · NEW JERSEY

U. S. Manufacturers Outdo Germans

(*Continued from page* 54)

Backing up the stories of U. S. tank superiority is the incident related recently by Robert P. Patterson, undersecretary of war. In Libya, 90 U. S. light tanks went through a whole month on the battle front with only 12 minor mechanical failures, according to Patterson. Previously, five to 10 days' continuous operation without an overhaul was considered unusual. On the other hand, captured Nazi reports showed that of 65 German Mark III tanks, 44 fell out after a desert crossing due to severe damage to the engines. The captured German reports said:

"The fault was always the same. The motors cut out, the oil pressure fell and finally dropped to zero. If an attempt was made to drive after a change of oil, cylinders and pistons seized and finally the connecting rod of the third or fourth piston broke.

Ford Motor Co., which is turning out 32-ton M-4 tanks on more than one assembly line at Detroit, has its own armor plate mill which is producing non-buckling armor plate at a rapid rate. Ford engineers have developed a new time-saving method of straightening armor plate, which eliminates much cumbersome machinery. After two to four hours in the heat treat furnace the strip of steel is automatically pushed onto huge water-cooled dies, which immediately grip the plate with 2,500 tons of pressure. Two hollow platens, attached to the upper and lower jaws of the broad press, are fed cold streams of water which accomplish the quenching process in three to eight minutes.

This quenching technique has been used previously on smaller sections of steel but never to such large sections and thicknesses. Most rolling mills cool the armor plate by sprays or immersions, but the rapid cooling invariably results in the warping or buckling of the armor plate. So every mill must use huge straighteners to press the plate to the necessary flatness. This two-hour operation is dispensed with under the Ford process.

Ford engineers converted automotive facilities for tank manufacture. In one plant 85 per cent of the equipment in use is the same which produced engines for Ford automobiles. Redesign of the final drive cut machine time and speeded up final assembly. Other phases of interior design have been altered to increase the accessibility of vital parts for servicing. The gun mount, previously made of 27 fabricated parts, is now composed of three castings, and production time has been cut by two-thirds. Four buildings have been completely changed over for tank production.

Ford also has completed on schedule its first War Dept. contract for several thousand Pratt & Whitney 18-cylinder radial engines. Each of these engines contains 1,136 units and 10,164 parts. Under the accelerated aircraft production program recently announced by Donald M. Nelson, chairman of WPB, Ford probably will be asked to up its engine output. Nelson said that aircraft production by mid-1943 will be double the present rate and that he expects next year's total to exceed 100,000 planes. Nelson said that annual aircraft output ultimately will reach $30 billion. Production of aircraft parts will have to be stepped up greatly in excess of the increase in actual plane production, according to Nelson. He called the production of aircraft parts a "terrific job."

To help bring balance into the aircraft program, Nelson has appointed a new aircraft production board which will serve as a "Little WPB" for aircraft alone. It is headed by Charles E. Wilson, vice chairman of WPB and president of General Electric Co. Other members are Maj.-Gen. Oliver P. Echols, procurement chief of the AAF; Rear Admiral Ralph E. Davison, assistant chief of the Navy's Bureau of Aeronautics, and Harold E. Talbott, chief of the WPB aircraft division. Realignment of the Navy's aircraft procurement program in line with strategic

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The series of lapping operations performed as a matter of course in the Strom plant give Strom Steel Balls a degree of surface smoothness and sphericity that has always been unequalled in any other regular grade of ball. Only through such unique lapping practice can extreme precision be obtained.

Physical soundness, correct hardness, size accuracy, and sphericity are guaranteed unconditionally in all Strom Balls.

Other types of balls—*stainless steel, monel, brass* and *bronze*—are also available in all standard sizes. Write for catalog and prices.

Strom STEEL BALL CO.
1850 So. 54th Avenue, Cicero, Ill.
The largest independent and exclusive Metal Ball Manufacturer

A NEW FITCHBURG GRINDER

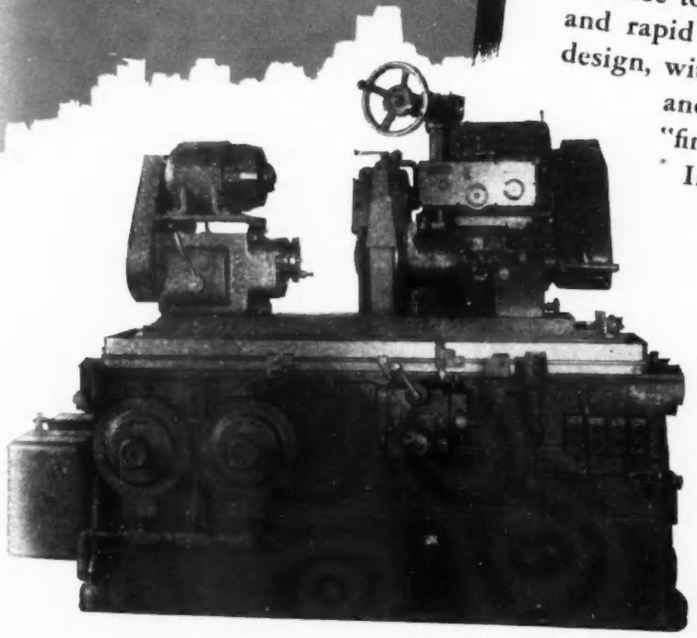
. . . . NEW AUTOMATIC PRECISION "TYPE B" PLAIN CYLINDRICAL GRINDER

Fitchburg announces another new grinder — the Fitchburg "Type B" automatic precision Plain Cylindrical Grinder. Into this new "Type B" are built all the essentials of rigid construction for accurate work and fine finish.

This new Fitchburg "Type B" Grinder is equipped with a Standard Bowgage Wheelhead unit with complete automatic cycle — rapid traverse to work, correct feed, grinding dwell and rapid return. This grinder is of modern design, with all mechanisms readily accessible and ease of operation is assured by "finger tip" controls.

In every detail it fills a definite need for a plain grinder where a machine is wanted for general plain cylindrical grinding, in large or small lots, with assurance of accuracy and fine finish at low cost.

Write today for complete details and information about machines with 10″, 18″, 48″ and 72″ capacity.



NEW FITCHBURG "TYPE B"—10 inch
PLAIN CYLINDRICAL GRINDER

FITCHBURG GRINDING MACHINE CORP.

FITCHBURG, MASSACHUSETTS, U. S. A.

Manufacturers of—Bowgage Wheelhead Units, Multiple Precision Grinding Units, Spline Grinders, Cylindrical Grinders, Gear Grinders, Bath Full Universal Grinders and Special Purpose Grinders.

development is responsible for the cancellation by the Government of the contract with the Nash Kelvinator Corp. to build huge Vought-Sikorsky cargo carrying flying boats at a new assembly plant in New Orleans. The partially completed New Orleans plant will be taken over by an aircraft company for the manufacture of patrol bombers, which are urgently needed by the Navy. This will leave the Nash Kelvinator plants in Michigan and Wisconsin, formerly devoted to body manufacture and refrigerator cabinet making, without war assignments for the present. These plants were scheduled to produce airframe subassemblies for the New Orleans plant. The excalibur type flying boats which Nash was to produce were to be made of aluminum, so the shortage in that metal probably was another reason for cancellation of the contract and diversion of the aluminum to combat planes.

In announcing the Nash contract cancellation, Rear Admiral E. M. Pace, Jr., Director of the Navy's materials division said that quick revision of the Navy's aircraft requirements in view of developments in the Pacific was the reason. He said increased production of combat planes and fast patrol bombers is needed immediately, so facilities must be diverted to these types. Charles F. Kettering, research director of General Motors, recently estimated that the U. S. is producing airplane engines at a rate of 8 to 10 million hp. monthly.

George Romney, managing director of the Automotive Council for War Production, has estimated that 75 per cent of 1942 aircraft production will be done by aircraft companies and 25 per cent by the automotive companies. Romney recently visited the Pacific Coast to confer with the Aircraft War Production Council, Inc., on details for an interchange of information between the West Coast group and the ACWP.

Obituary

Charles Eugene Schneider, 74, France's greatest arms magnate, died Nov. 17 at his Paris home.

Joseph C. Harley, 73, a Buick dealer in Detroit, died recently of a heart attack. He was president and owner of the Harley Buick Sales Co., which he organized in 1917 after a period as Detroit retail sales manager for Buick.

William A. MacFarland, 74, Detroit representative of the Abrasive Co. and a pioneer in the introduction of abrasive tool cutting in the automobile industry, died Nov. 4 at his home in Detroit.

Frank J. Weschler, vice-president of the Chain Belt Company of Milwaukee, and general manager of Baldwin-Duckworth, a division of Chain Belt Company at Springfield and Worcester, Massachusetts, died suddenly on November 10 in Worcester.

C. L. Weberg, 58, assistant comptroller of foreign operations for Goodyear Tire and Rubber Co., died November 12, following a heart attack.

John J. Klein, 32, assistant secretary of The Marmon-Herrington Company, died November 11 of pneumonia, after a four days' illness.

George M. Schebler, 77, inventor of one of the first commercially successful carburetors, died November 16 in the Batesville hospital at Indianapolis.

John J. Klein, 32, assistant secretary of the Marmon-Herrington Co., died suddenly Nov. 11 in Indianapolis. He was a member of the SAE.

H. Albert Schmidt, 73, one of the founders of the AC Spark Plug Co., died Nov. 12 at Encino, Cal. With Albert Champion and W. C. Durant, he organized the AC concern at Flint in 1908. He was a vice-president of AC until he sold his interest in 1919 to General Motors Corp. Later he served as an engineer for Buick.

George C. Jessop, 56, general superintendent of the Chevrolet armored vehicle assembly plant at Flint, died Nov. 14 at his home in Goodrich, Mich. He had been with Chevrolet since its organization in 1911, starting as a test driver.

Virgil Oldberg, 63, former president of the Oldberg Mfg. Co., Grand Haven, Mich., died Nov. 15 at his home in Detroit. He was at one time service manager of the Hudson Motor Car Co. and at the time of his death he was associated with Vickers, Inc.

40 YEARS AGO

VERMONT RAISES SPEED LIMIT

The Topeka, Kan., board of aldermen will increase the auto speed limit, proposed at six miles. In Waterloo, Iowa, an automobile ordinance passed its first reading Nov. 10. The speed limit is eight miles per hour. The lower house of the Vermont Legislature on Nov. 14 concurred in the amendment to the State automobile law raising the speed limit from 12 to 15 miles per hour.

From *The Horseless Age*, Nov. 26, 1902.

LITTELFUSE

√ Elements Twisted at 90°

A second Littelfuses feature that provides additional

BRACING AGAINST VIBRATION

Above diagram greatly enlarged, shows a distinctive LITTELFUSE characteristic vitally important in the high mechanical strength, fatigue—and *vibration* resistance of

AIRCRAFT ANTI-VIBRATION TYPE

LITTELFUSES

But this is only one of the features that mean longest life, utmost dependability in Littelfuses.

4 AG Aircraft Anti-vibration type. Note twisted element.

EXCLUSIVE LITTELFUSE DESIGN

(1) Locked cap assembly.
√ (2) Element twisted at 90° braces against vibration.
(3) "Goose-neck" non-crystallizing fuse element takes up contraction and expansion. Solves heat problem.

SEND FOR COMPLETE LITTELFUSE CATALOG

Above features and others explained in detail. Littelfuses for aircraft, radio, ordnance, and marine services, communications, every instrument purpose. Clips, Mountings, Panels, Extractor Posts, all accessories. Write.

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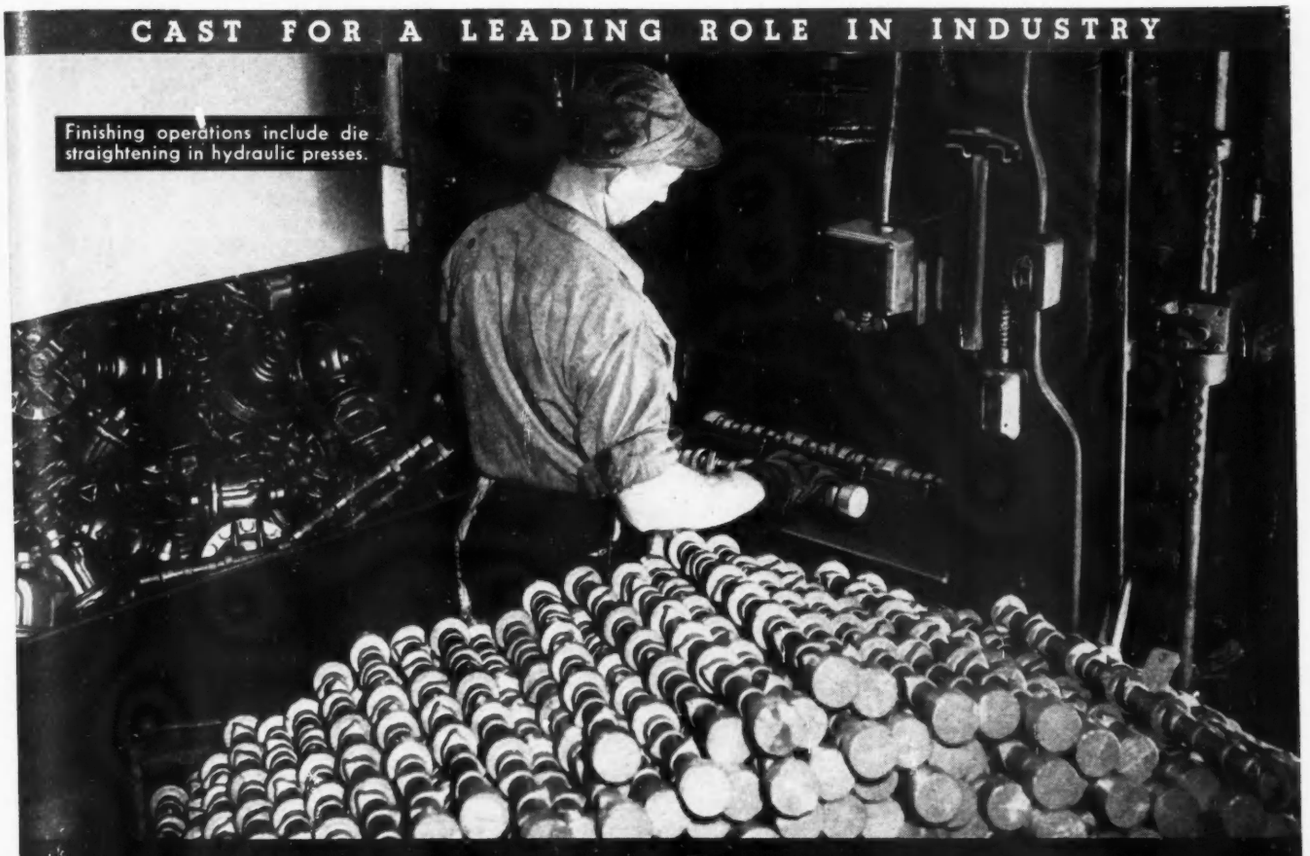
CAST FOR A LEADING ROLE IN INDUSTRY



ArmaSteel* Is Right When It Gets to You

There's no room for misfits in the daily shipments of ArmaSteel castings that leave our foundry for varied assignments in industry. Long before the finishing operations are performed, any defective castings will have fallen by the wayside under a barrage of checks and tests—magna-fluxing, deep-etching, chemical analysis, electric-resistance tests, and others.

While flaws are few and far between, it is important that what rejections there are should take place in our plant, not yours. Your only concern is to take full advantage of the savings in machining time and tool wear that ArmaSteel castings effect in your manufacturing operations. ArmaSteel replaces critical materials and improves the performance characteristics of vital parts in a variety of applications. Write for information.

TYPICAL APPLICATIONS

Diesel pistons for heavy-duty locomotives . . . Automotive piston rings, camshafts, Hydra-Matic transmission gears, driveshaft universal yokes, clutch throwout collars, valve rocker arms . . . Refrigerator crankshafts and connecting rods . . . Washing machine drive gears.

Saginaw Malleable Iron Division
General Motors Corporation **Saginaw, Michigan**

GM SAVE SERVE

*Reg. U.S. Pat. Off.

CAST FOR A LEADING ROLE IN INDUSTRY

Strikes Continue to Hinder War Plants

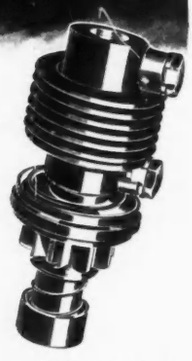
(*Continued from page* 54)

CIO be postponed indefinitely so that undivided attention can be devoted to the war effort was rejected by Leo Lamotte, the union's Chrysler Dept. director. The present contract has been in effect since Nov. 29, 1939, although the wage provisions were altered by a WLB directive of Oct. 3 which ordered a 4-cent per hour wage increase. The union has proposed 99 contract changes, including more shop stewards, the dues checkoff and closed shop. Pointing out that hourly earnings in Chrysler plants are now $1.28 per hour and that weekly earnings average $58, Robert W. Conder, Chrysler director for labor relations, wrote, "Chrysler does not believe this is the time to enter upon prolonged negotiations for the detailed revision of any union contract, particularly a contract in force in plants engaged exclusively on war production. We believe this is the time for the company and its employes to devote their undivided attention to increasing the output of vital war material. . . ." Lamotte charged that Chrysler was trying to negotiate the contract in the newspapers but he said the union would be favorable towards negotiating a new contract for the duration of the war, such as the union negotiated in the case of the Ford contract. The negotiations began Nov. 17 at Detroit.

A one-day strike in 15 key war plants in Detroit was terminated when Lewis Gill, regional director of the WLB at Cleveland, intervened. Matthew Smith, secretary of the Mechanics Educational Society of America, an independent union, called the "labor holiday" after a jurisdictional dispute at the Briggs aircraft division. Smith, who has criticized the UAW-CIO for surrendering its right to strike during the war emergency invoked the sympathy strike in order to get action from the WLB on the case of eight electricians who were dismissed at the Briggs plant. The MESA, which had petitioned for an NLRB election among tool and die maintenance men at the Briggs aircraft unit, attempted to distribute literature there derogatory to the UAW-CIO and later tried to set up a picket line. The eight electricians, MESA members, left their jobs at that time, some being escorted from the plant. Smith claimed the "holiday" was called in order to obtain the quick attention of the WLB over the jurisdictional matter, although it held up vital war work in such plants as Nash-Kelvinator Corp., Michigan Tool Co. and a number of smaller tool and die companies employing a total of 9200 men.

Gill, who helped settle this strike, is one of 10 regional directors of WLB, which has set up offices in Boston, New York, Philadelphia, Atlanta, Kansas City, Cleveland, Chicago, Dallas, Denver and San Francisco. Regional advisory boards, composed of four men each representing the public, industry and labor, also will be set up in each region to assist in administration of the wage stabilization program. The board for Region Five, comprising Michigan, Ohio, West Virginia and Kentucky, is composed of Eddison Bowers, economics dept., Ohio State University chairman; T. J. Donahue, chairman of the Michigan Labor Mediation Board; Dr. C. V. Thomas, president of Penn College, Cleveland, and David A. Wolff, Detroit attorney, representing the public. Industry members are S. W. Utley, president of Detroit Steel Castings Co., C. M. White, vice president of Republic Steel Co., Cleveland; T. G. Graham, vice president of B. F. Goodrich Co., Akron, and T. J. Conway, vice president of Fisher Bros. Co., Cleveland. Labor members are P. E. Miley, regional director of the UAW-CIO, Cleveland; Jesse Gallagher, AFL organizer, Cleveland; N. H. Eagle, national representative of the United Rubber Workers (CIO), Akron, and T. A. Lenahan, secretary-treasurer of the Cleveland Federation of Labor (AFL).

Our boys are hitting the enemy hard on every front. And supporting them with fast, dependable starting action is the rugged "BENDIX" Drive — found on Uncle Sam's deadly gun carriers. This tough little unit is adding new service stripes to its already unsurpassed service record; a record won in peace-time years for reliable starting action in 60 million engines. And in replacement service, too, it's tops.



The "BENDIX" Drive is a vital member of "The Invisible Crew" — the precision equipment built by 25 Bendix plants from coast to coast and serving with our fighting crews on every front.

THE INVISIBLE CREW
Precision Equipment by Bendix
AVIATION CORPORATION

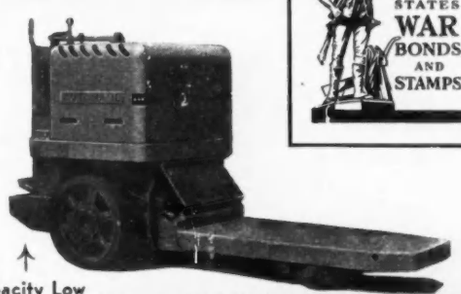
ECLIPSE MACHINE DIVISION

FOR *Victory*

APPROVED TYPES TO CONSERVE VITAL MATERIALS AND SPEED UP WAR PRODUCTION MATERIALS HANDLING

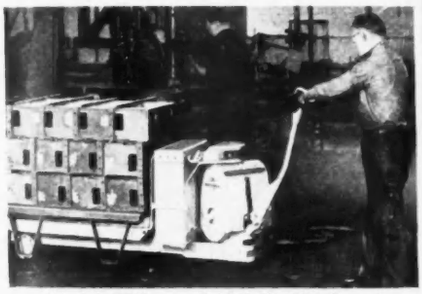
Let the "AUTOMATIC" representative supply you with full details and show you how the standard approved models can be efficiently applied to your present material handling problems and still be highly efficient for post war production work.

"AUTOMATIC" representatives are listed in the classified telephone directories in the principal cities and industrial areas under "TRUCKS INDUSTRIAL."



Model "LN-2" 4000 Pound Capacity Low Lift Elevating Platform Truck for Skid Transportation. Standard Platform Is 55" Long, 26" Wide, 10¼" High with 6" Lift.

LIFT TRUCKS



Model "TN-4 and TW-4" 4000 Pound Capacity and Model "TN-6 and TW-6" 6000 Pound Capacity "TRANSPORTER" Platform Type Lift Trucks for Skid Platforms — Standard Platform Lengths 36" to 72" in 12" Steps. Widths 20" and 26½"; Heights in Low Position 6"; 7"; 9"; 11"; (For Full Details Get "TRANSPORTER" Platform Bulletin).

Model "LO-5" 10,000 Pound Capacity Low Lift Elevating Platform Truck for Skid Transportation. Standard Platform is 60" Long, 26" Wide, 11" High with 5" Lift.

Model "LN-3" 6000 Pound Capacity Low Lift Elevating Platform Truck for Skid Transportation. Standard Platform Is 55" Long, 27" Wide, 10¾" High with 6" Lift.

Model "TETF-7" Rear Control 7000 Pound Capacity Telescopic Tilting Tiering Fork Lift Truck for Unit Loads on Pallets or Skid Platforms. Standard Forks Up to 36" Long. Telescopic Lift Up to 119".

NOTE:—Some "AUTOMATIC" approved models can be furnished with specifications meeting "Industrial Truck Association Spark-Enclosed Equipment" for operation in heavily laden dust or vapor atmosphere such as in arsenals, ammunition depots and ordnance or chemical warfare plants. These are models "LN-2"; "TLN-2"; "THTF-L-4"; "THTF-L-6" and "TRANSPORTER" platform and pallet type lift trucks.

Model "THTF-L-6" Center Control 6000 Pound Capacity Telescopic Tilting Tiering Fork Lift Truck for Unit Loads on Pallets or Skid Platforms Standard Forks up to 36" Long. Telescopic Lift up to 119".

Model "THTF-M-10" Heavy Duty Center Control 10,000 Pound Capacity Telescopic and Non-Telescopic Tilting Tiering Fork Lift Truck for Unit Loads on Pallets or Skid Platforms. Standard Forks Up to 36" Long. Telescopic Lift Up to 98".

AUTOMATIC TRANSPORTATION CO.

DIV. OF THE YALE & TOWNE MFG. CO.

57 WEST 87th STREET CHICAGO, ILLINOIS

Automotive Production Methods Cut Manpower Requirements

(*Continued from page* 17)

workers will have to be added in the next six months, although bigger draft quotas may up these requirements to some extent, as occupational deferments probably will be scaled down to a minimum. These lower estimates are predicated upon adoption of the 48-hour work week, a move which probably would avert the need for approximately 50,000 additional workers. Preservation of union standards and the problem of time and one-half pay for work beyond 40 hours in a week might prevent the 48-hour week from becoming an actuality. If overtime were paid, the cost to the government and the inflationary effect would be considerable.

An important factor that has been overlooked in the changing labor requirements for war production is the technological improvement that has been achieved by the automotive engineers. They have taken hand-produced weapons whose manufacture formerly was confined to arsenals and so adapted them to mass production that phenomenal results have been obtained in saving man-hours and production costs. Pontiac Motor Division of General Motors cut the production time on the Oerlikon anti-aircraft gun from 428 to 197 man-hours, a reduction of 54 per cent. The latest man-hour production figure also includes 40 hours of labor on spare parts and other parts formerly subcontracted which were not included in the original production total.

ALLSIZE
UNIVERSAL HOSE CLAMP
AN APPROVED, SELF-LOCKING CLAMP THAT ACCOMMODATES ANY RANGE OF DIAMETER SIZES
Completely Universal
IDEAL FOR ALL HOSE AND GENERAL CONNECTIONS
● 100% Self-Locking
● Easiest to Use
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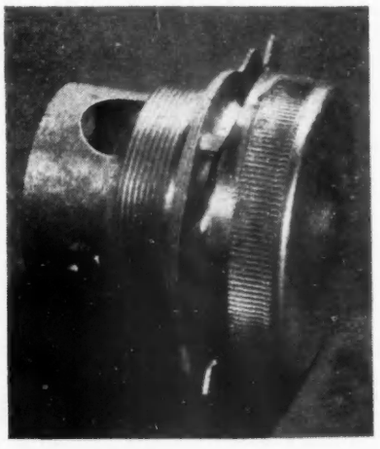
A single All-Size Clamp replaces more than a hundred preformed sizes. It has been tested and has proved superior in both production and service work. America's leading manufacturers of defense equipment use and favor All-Size Clamps—because they are definitely easiest to use . . . are completely self-locking . . . have sufficient take-up for use on synthetic rubber hose . . . and can be installed around and removed from connected lines, and are usable over and over again on either larger or smaller sizes.
All-Size Clamps come flat in any length to fit any desired range of diameter sizes, thus making it unnecessary to stock an expensive inventory of different sizes. They embody all the qualifications of the strongest clamps made—but cost much less! . . . If you now use clamps, learn how All-Size can save you time, labor and money—and still give you far more effective results.
SEND TODAY FOR FREE SAMPLES AND PRICES
ALLSIZE
CENTRAL EQUIPMENT CO.
1018 SO. WABASH AVENUE ★ CHICAGO, ILLINOIS

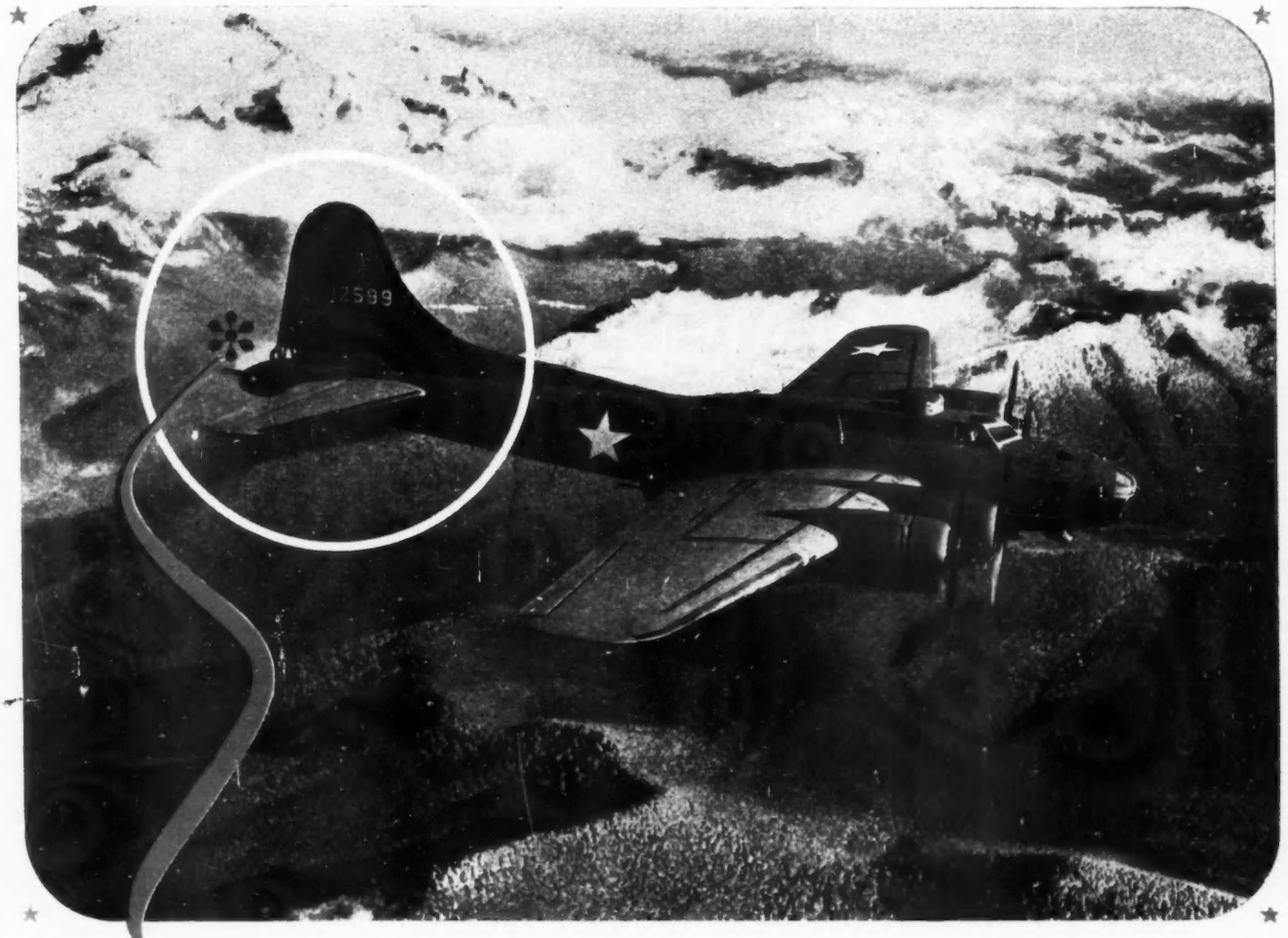
Air Cargo Research Association Formed

Completion of permanent organization, election of officers and appointment of chairmen for specialists' committees has been announced by the Air Cargo Research Association, a new group of technicians formed to prepare both aircraft builders and the American shipping industry for global air transport.

Thomas Wolfe, vice-president of traffic for Western Air Lines, was named general chairman of the research association, with other officers as follows: James F. Hall, shipping coordinator for North American Aviation, Inc., first vice-chairman; Gordon Brown, manager of contract administration, cargo and transport aircraft for the Douglas Aircraft company, second vice-chairman; Jack B. Sheehan, manager of industrial research for the Lockheed Aircraft Corporation, secretary; and William A. Lippman, treasurer.



Aircraft gas tank cap made by Poulsen & Narden, Inc., Los Angeles, California. The tubular parts are deep-drawn from flat stock and the lugs for holding the cap to the tank portion of the assembly are formed automatically during the stamping operations.



How does a Bomber Pilot

COMMAND TONS OF PRESSURE WITH POUNDS OF EFFORT?

YOU'VE seen a heavy bomber change direction in the air—climb, bank or nose down. It looks easy, although the airstream is actually piling tons of pressure against the rudder and tail surfaces.

It even looks easy in the cabin, as you watch the pilot handle his controls. And it is easy, because a little trick called an "amplidyne"—which steps up electrical power input to the control motors about 10,000 times—is doing the work for him.

This mechanism, a development of one of the nation's largest electrical manufacturers, depends upon the special properties of an Allegheny Ludlum Electrical Steel to achieve its results. Into the steel, as it must be in the amplidyne itself, is built reliability, uniformity and stamina.

Although important, this is only one of the dozens of wartime electrical devices to which Allegheny Ludlum Electrical Alloys have lent desirable qualities of magnetism, high permeability, or high resistance. The list covers control, detection and communications equipment for all the services.

For engineers and production men desiring certified technical information on these special alloys, write for a copy of the *"Electrical Materials Blue Sheet."* If you need assistance on fabricating problems, our Technical Staff is at your service.

Allegheny Ludlum
STEEL CORPORATION
GENERAL OFFICES: PITTSBURGH, PENNSYLVANIA

Steel-Makers to the Electrical Industry

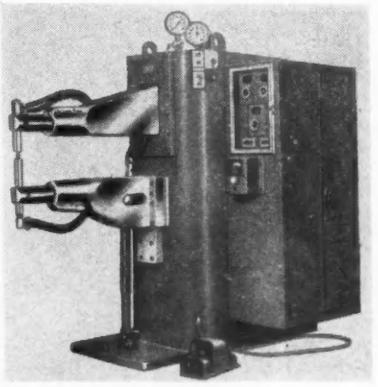
A-8689 . . . W & D

New Production Equipment

(*Continued from page* 48)

are supplied to provide for a heating section and a holding or soaking section. Burner equipment may be supplied with height adjustments when cases of different sizes are to be annealed in one machine.

SCIAKY BROS., Chicago, Ill., now offer a new rocker arm resistance welder, type PMCR.2S16 for the spotwelding of aluminum and its alloys. This machine embodies all the features found in their regular line, such as, stored energy with preheating and variable pressure with precompression. Other features are adjustable electrode tips, which may be set at any angle without impairing their proper welding position, and the placing of all gages and dials on the frame of the machine, clearly visible to the operator. This machine supplies a total pressure of 3000 lb. between the electrode tips from a supply line of 90 lb., using normal throat depth of 34 in. It has a welding capacity of .080 in. plus .080 in., 24ST Alclad. Welding stroke is ½ in. and retraction stroke 3½ in. A special face plate at 45 deg. can be incorporated with the vertical face plate for special work.



The Sciaky Rocker Arm Resistance Welder.

BRUSHES that look like discs with two square corners and rotate like a spinning coin are being produced by the Osborn Manufacturing Company, Cleveland, Ohio, for service in industry to remove rust, scale, rubber, burrs, sharp corners, dirt and chips from metal holes, cavities and recesses. The "Sibot" brushes, as they are called, will clean both the bottoms and side walls in the cavities of various machined, stamped, cast and forged parts in one operation. The fixtures for operating are usually very simple. The brushes may be inserted into the chuck of an ordinary drill press, for example. The Osborn Sibot brushes are made of wire in two ringlock sections with a metal shank in between, constructed in a way that makes it impossible to injure the work if proper conditions exist.

The Osborn "Sibot" brush

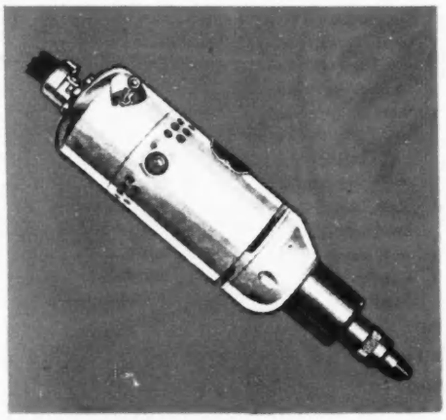
FEATURING a dual clamping arrangement which separately holds the boring bar in the holder and the holder to the lathe, the Clayton Manufacturing Company, Alhambra, Cal., announces production of large type bars and bar

(*Turn to page* 82, *please*)

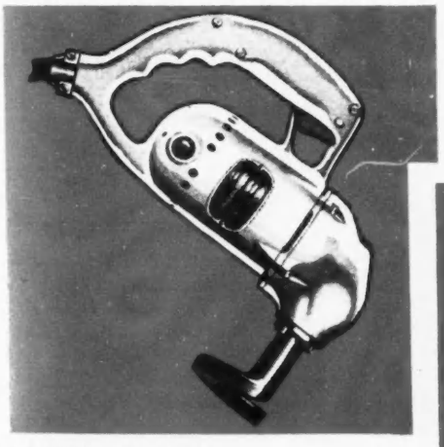
TOTAL STRENGTH..
Total strength is a quality found only in laboratory controlled Drop Forgings. Cost departments are constantly searching for lower production expense, and that is a laudable thing to do. But first costs do not solve any production problem. You have to see it through, to final machining and actual, unfailing use. Here's the reason why Atlas Drop Forgings (Laboratory Controlled) are more in demand than ever before.
ATLAS
DROP FORGINGS
ATLAS DROP FORGE CO., LANSING, MICH.

Where can you save MORE time with MORE Black & Decker Tools?

ELECTRIC DRILLS—capacities from ¼" to 1¼"—including the famous **HOLGUN**—with wide choice of spindle speeds and handle arrangements for every type of aircraft work.



POWER DRIVERS—sizes to drive anything from small screws to large nuts and bolts; clutch adjustments, angle heads and controls to drive all threaded-fastener assemblies.



LECTRO-SHEARS—speed up sheet metal cutting—either straight-line or intricate pattern work, down to minimum cutting radius of ¾". Cutting operation always visible. 2 sizes—18 and 16 gauge.

GET IN THE SCRAP WITH YOUR SCRAP

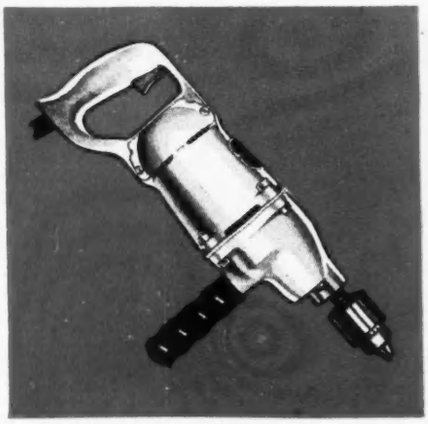
On aircraft parts, sub-assemblies and assemblies, on aircraft engines, equipment and armament, countless jobs are being done faster today—thanks to the advanced engineering and built-in quality of Black & Decker Portable Electric Tools.

A few of these tools are pictured here. Many more are shown in our new catalog. For a copy of the catalog—and as a dependable, convenient source of supply—phone your near-by Black & Decker Distributor. Or write to: The Black & Decker Mfg. Co., 781 Pennsylvania Avenue, Towson, Maryland.

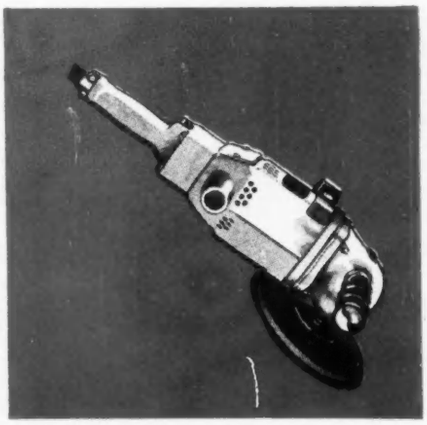
LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker

PORTABLE ELECTRIC **TOOLS**



ELECTRIC TAPPERS—for hole threading at high speed with less tap breakage. Capacities up to ⅜" in cast iron, ¼" in steel, ½" in brass or aluminum. Reverses automatically. Universal motor.



ABRASIVE TOOLS—Sanders, Portable Grinders and Bench Grinders—for smoothing, cleaning, buffing, wire brushing and sharpening operations. . . . on metal, wood or plastics. Vital parts sealed against dust.

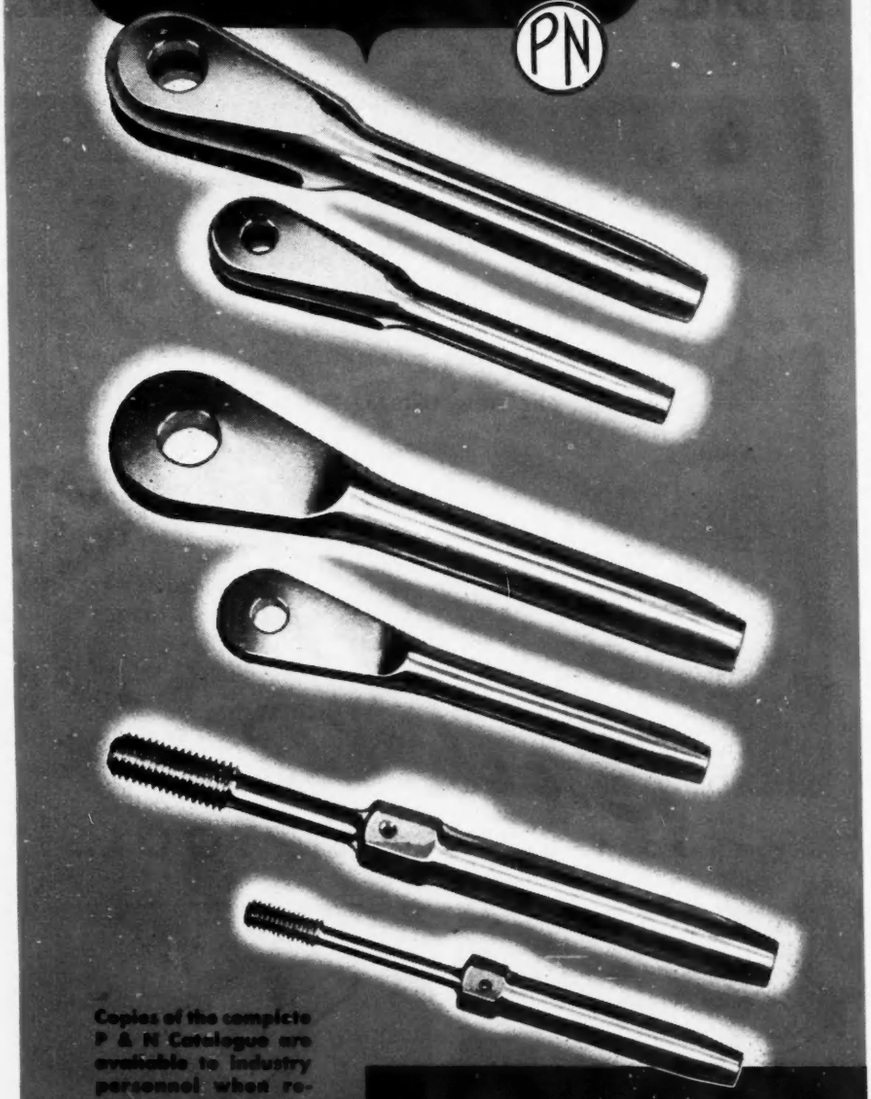
CABLE TERMINALS

★ All Standard Types

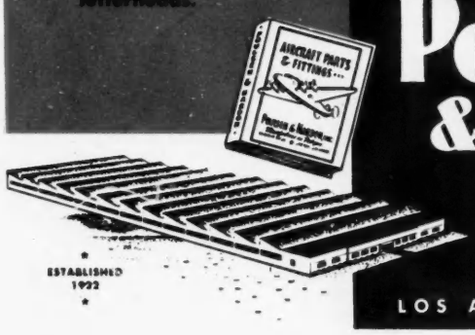
★ All Required Sizes

★ Millions being supplied to leading manufacturers

PN



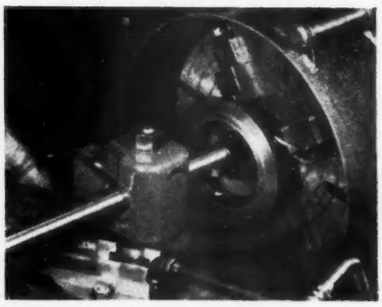
Copies of the complete P & N Catalogue are available to industry personnel when requested on company letterheads.



POULSEN & NARDON, INC.

LOS ANGELES · CALIFORNIA

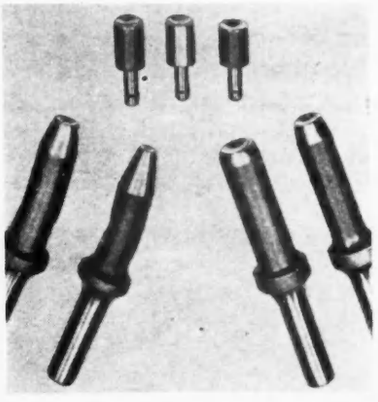
(*Continued from page* 80)



The Clayton Boring Bar and Holder.

holders for lathes having swings of from 9 in. to 36 in. The special design allows removal of the holder from the lathe without changing the height of the bar or the distance which it extends out from the holder. It is possible also to remove the bar without changing the alignment of the holder. The bars are calibrated for length, at each end, and Allen screws are used to hold the tool bits.

ADDITIONS to their line of Aerocraft rivet sets, by Aircraft Tools, Inc., Los Angeles, Cal., have broadened it to include practically every type of rivet set used in the aviation industry. Aerocraft rivet sets are now made in all standard sizes, either straight or offset



Aerocraft Rivet Sets showing straight, offset and squeezer type.

type. for round head, brazier head, flat head and modified brazier head rivets from 3/32 in. to ¼ in. diameter as well as swivel type flush rivet sets, straight flush rivet sets with 1¼ in. heads, and hand rivet squeezer sets in 3/32 in. to 3/16 in., round and brazier heads.

A SCREW conveyor feed has been added to American wet disposal units to provide a constant and uniform rate of feed of discharged dust from dry type dust collectors into the sludge forming device. The American wet disposal unit, manufactured by the American Foundry Equipment Co., Mishawaka, Indiana, is designed to make a wet sludge of the dust discharged from the hoppers of dry type dust collectors by centrifugally mixing the accumu

(*Turn to page* 84, *please*)

Bartlett·Snow

WEIGH LARRIES

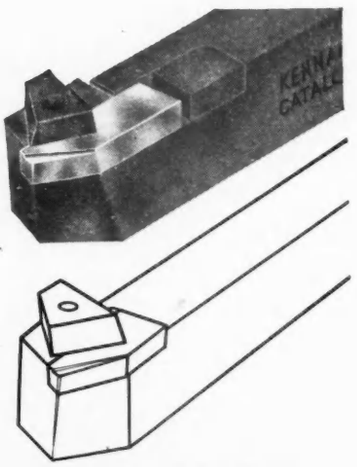
—make it possible to keep an accurate record of the coal being fed to each boiler—prevent the segregation of coal—and permit an entire row of boilers to be supplied from a single bunker located at the end or entirely outside the building, resulting in substantial savings in building and bunker costs. Hand propelled and motor driven types in capacities from ½ ton to 20 tons per single trip. Eng. Bul. No. 83 sent on request, gives full details. The C. O. Bartlett & Snow Co., 6208 Harvard Avenue, Cleveland, Ohio.

(*Continued from page* 82)

lated dust with water or other liquids.

Dust which falls from the dust collector hopper through a flexible coupling is deposited directly into the screw conveyor of the wet disposal unit. The rate at which this dust is then fed into the mixing chamber can be controlled through a gear speed reducer and variable speed motor pulley. At the time dust enters the unit, water or other liquid is discharged at the center of a high speed mixing disc, causing an instantaneous mixture of the two. The sludge is then discharged at the bottom of the unit.

A NEW type clamped-on carbide tipped tool which features a clamp secured by a screw which is inserted from the bottom of the tool, through the shank, is being produced by McKenna Metals Company, Latrobe, Pa. A flat surface is milled on the shank to accommodate the cutting tip, which is held in position by the clamp. This construction eliminates any mechanical device at the top of the clamp which might hinder the most efficient use of the tool. Provision is made for placing shims back of the tip after it has been reground. Kennametal clamped-on tools are available in three square sizes—1 inch, 1¼ inch, and 1½ inch, and in two flat sizes, 1 inch x 1½ inch and 1½ inch x 2 inches.



Kennametal clamped-on type carbide tipped tool

AIRCRAFT-MARINE PRODUCTS, INC., Elizabeth, New Jersey, announces a new solderless flag type terminal which meets the need for stacking a series of parallel terminal connections on a single stud block without loss of space or electrical conductivity. This is made possible by a unique design plus a sufficiently flexible tongue to permit multiple stacking after wiring. These solderless terminals may be used for either right or left hand application,

Solderless flag-type terminals

since the terminal barrel is symmetrically located with respect to the plane of the tongue.

For wire sizes 22 and 10, these new terminals are pure copper of maximum conductivity and hot electro-tinned for maximum corrosion resistance.

No solder is necessary, the terminals are crimped on wire with hand, foot or power tools. Special designs for particular applications are available.

A NEW AC transformer type welding machine that combines safety with improved operating efficiency is announced by Wilson Welder and Metals Co., Inc., New York. The most interesting feature of the new Wilson "Bumble Bee" welder is its low open circuit voltage of 42 volts, automatically maintained by means of recent Wilson engi

(*Turn to page* 87, *please*)

"CINCINNATI" Milling Machine — Dial Type
All bearings in saddle unit Bijur-lubricated
The correct oil film to each individual bearing... automatically
make your product BETTER!

• BIJUR-equipped machines *hold* efficiency . . . maintain accuracy of work . . . permit both higher-quality and higher-speed production. • Positive "metered" lubrication insures smooth running — reduces many items of cost. • Adapted to any machine design . . . Bijur equipment makes your machine a more profitable investment!

BIJUR LUBRICATING CORPORATION • LONG ISLAND CITY, NEW YORK

1210

BIJUR

AUTOMATICALLY *Correct* LUBRICATION

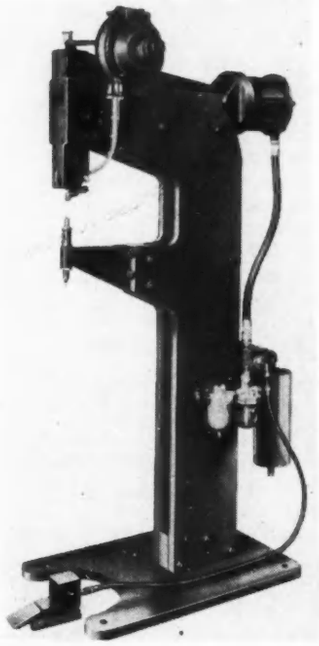
(*Continued from page* 84)

neering developments. Two primary coils are used instead of the usual one, with a magnetic contactor in the circuit of one primary. Each primary contributes approximately 42 volts to the total open circuit voltage, which is actually 84 to 85 volts. When the machine is idle, one primary is automatically cut out, restricting the open circuit value to 42 volts. As soon as the electrode contacts the work, the second primary is thrown into the circuit, and if there were not a dead short, the voltage would be 84-85 volts.

When the operator draws an arc, this open circuit potential of 84-85 volts enables him to establish his arc quickly. Most welding operations are performed at between 32 and 40 volts. When welding is completed and the operator pulls out or lengthens his arc, the arc voltage rises. When it reaches 45 volts, the contactor opens and cuts out one primary, leaving only 42 volts in the open circuit.

Power factor correction is provided with built-in capacitors on all four sizes —300, 500, 750, and 1000 amperes, resulting in a power factor of 100 per cent to 86 per cent (lagging) over the popular working range. With Wilson's new wiring arrangement, capacitors are cut out when the machine is idle.

DESIGNED to afford increased speed and efficiency of flush riveting in aircraft production, the new "Rivitor," manufactured by the Tomkins-Johnson Co., Jackson, Michigan, is air powered with automatic feed and setting mechanism. Pressure for riveting is furnished by an air cylinder and applied through a toggle mechanism. The machine is designed to handle aircraft requirements for aluminum alloy riveting, with capacity for rivets of ¼ inch diameter, ¾ inch long. By using a different type of rivet set and rivet jaw construction, this machine can also be adapted to handle counter-sunk head, round head, full and semi-brazier head rivets. It is available in throat depths ranging from 9 inches to 36 inches.



The new air powered "Rivitor"

STEEL carrier frames built up with wood liners, made by Lyon Metal Products, Inc., Aurora, Ill., are designed for storing and protecting finished parts and tools. These frames are made with no bottom, but with side walls formed into a channel shape to strengthen and hold wood inserts in position and with a heavy steel lug at each corner which permits several frames to be fastened or stacked together to form one rigid unit. Lyon carrier frames are made in two sizes, 30 in. x 20 in. x 5¾ in. and 30 in. x 30 in. x 3¾ in. The maker furnishes only the steel frames; the wood inserts are made by the user to meet his own requirements.

A New Bonding Ring

New bonding rings to be used wherever there is need for bonding between

(*Turn to page* 88, *please*)

KENNAMETAL*... Style 11

the lathe tool that will expand your *Production*

KENNAMETAL'S qualities of hardness, crater resistance, and transverse rupture strength combine to give increased production on turning, boring, or facing operations on steel.

The illustration shows a style 11 KENNAMETAL tool taking a turning cut on a tinning roll at a speed of 210 ft./min. with a cut of 1/4" depth and 1/32" feed. Note the finish achieved on the initial cut; KENNAMETAL, by frequently taking a finish and rough cut in one operation, decreases floor to floor time and increases production.

For your boring, turning, and facing operations on steel, use KENNAMETAL for increased production with current equipment.

KENNAMETAL THE All American CARBIDE

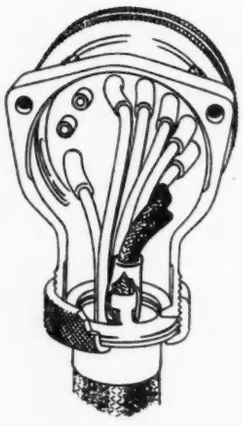
* INVENTED AND MANUFACTURED IN U. S. A.

McKENNA METALS Co.

105 LLOYD AVENUE, LATROBE, PENNA.

Foreign Sales: U. S. STEEL EXPORT CO., 30 Church St., New York. (Exclusive of Canada and Great Britain)

Trade Mark Reg. U. S. Pat. Off.



Cannon Bonding Ring installed on 90 degree connector.

(*Continued from page* 87)

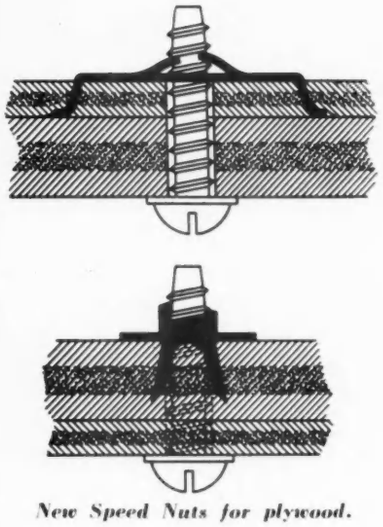
electrical plug shells and wire shielding, are announced by the Cannon Electric Development Company, Los Angeles, Cal. The Cannon Bonding Rings may be used with either flexible coupling nuts or cable clamps. The rings are used almost exclusively at present in bonding shielded radio and instrument circuits, but are adaptable to many other applications where a tight bond is required. They will fit a variety of conduit nuts.

Lathe Center Lubricant

A new lubricant for the dead centers of lathes has been developed by Joseph Dixon Crucible Company, Jersey City, N. J. The product is a combination of pure flake lubricating graphite and other specially formulated ingredients made to withstand the extremely high pressures and temperatures developed at the dead center in lathe work. Rigid two-year tests by experienced lathe hands on all types of lathes and work have demonstrated that Dixon's Lathe Center Graphite Lubricant effectively controls overheating and protects dead centers against scoring and softening, reducing wear of the dead center.

Self-Attaching Speed Nuts For Plywood

A new Speed Nut for plywood, which is said to be the only self-locking nut which can be driven instantly into anchored position, is offered by Tinnerman Products Inc., Cleveland, Ohio. It is designed with two pairs of integrally formed attaching legs. When driven into thick plywood, the cam-like structure of the attaching legs forces them outward as they are driven into the plywood, holding the Speed Nuts permanently with firm spring-tension grip in the wood. When used with thin plywood, the attaching legs peen over when driven against a backing plate. Other advantages claimed for this self-locking Speed Nut are its light weight of 3½ lb. per thousand and its large bearing surface. Speed Nuts for plywood are made for use on both Air Corps 530-8 and Air Corps 530-10 screws.



New Speed Nuts for plywood.

Power Bottles for Aircraft

Carbon dioxide gas, already used to put out airplane, tank, marine and industrial fires and to inflate rubber rafts and life-vests, has now been harnessed as a source of emergency power through a device developed by engineers of Walter Kidde & Company, Bloomfield, N. J. Known as Power Actuator Cylinders, the new devices consist of steel bottles filled with compressed carbon

(*Turn to page* 90, *please*)

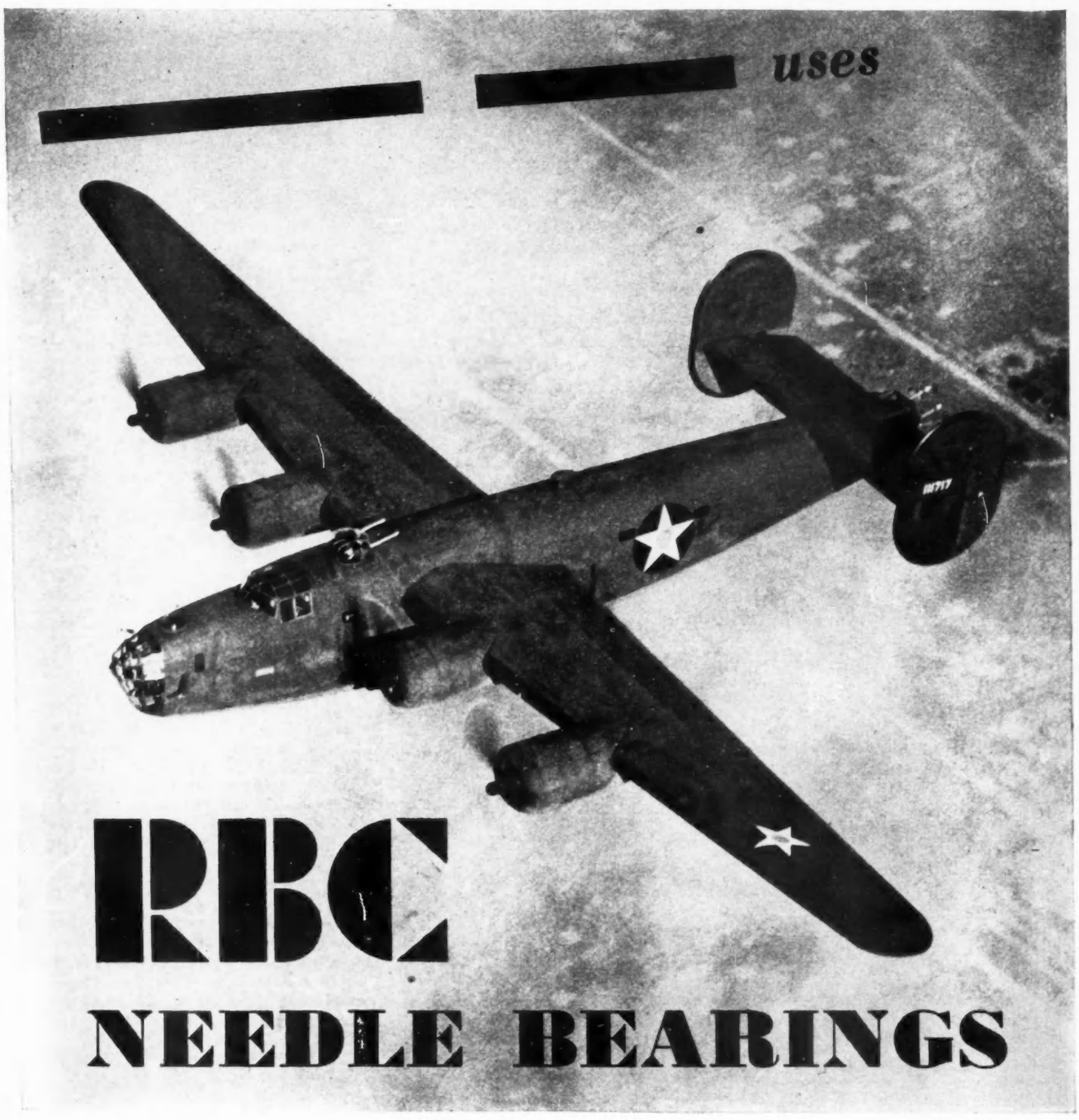
NOW YOU CAN STANDARDIZE ON
WORK-BENCHES, TOO!

Fig. 928 Pat'd and Pat's Pending. Drawer is extra.

HALLOWELL
SHOP EQUIPMENT

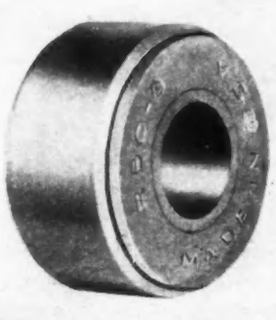
Spare yourself the delays and misunderstandings that often accompany the building of your own work-benches. Just choose the work-benches you need from 1367 ready-made "Hallowell" Work-Bench Combinations. "Hallowell" Work-Benches stand strong and rigid without costly bolting to the floor. Tops of smooth, laminated wood, Masonite, or if advantageous, of steel. Five leg heights and widths to select from is an exclusive "Hallowell" feature. Deliveries are better than average.

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. BOX 611
— BRANCHES —
BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO



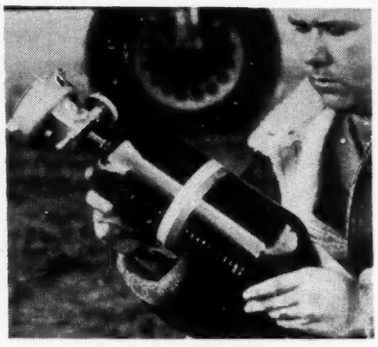
RBC
NEEDLE BEARINGS

Mission accomplished . . . headed for home and a happy landing! When they're flirting with death above the clouds, the pilot and crew have at least the right to expect that their ship can be set down smoothly and safely. That's why the landing gear of [redacted] Bombers are equipped with RBC Aircraft Bearings.



ROLLER BEARING CO. of AMERICA

TRENTON . . . . NEW JERSEY



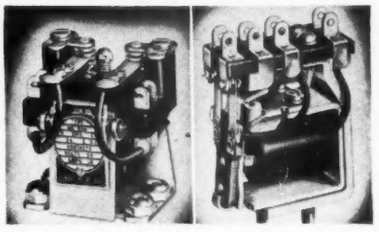
Power Bottle made by Walter Kidde and Company contains compressed carbon dioxide.

(*Continued from page* 88)

dioxide and connected to the cylinders of hydraulic systems used to open bomb bay dors, to lower retractable landing gear and to apply brakes. When the regular hydraulic system fails or is damaged by anti-aircraft or machine gun fire in combat, the compressed gas is released into the system to operate the pistons. Each cylinder holds a latent force of 30,000 foot lbs. per pound of compressed carbon dioxide.

New Small Power Relays

The Allied Control Co., New York, N. Y., announces that their Models BO and BJ Power Relays for flight, firing and communication control have been redesigned to require minimum mounting space and to permit variations in their mounting bases to make them widely interchangeable. They are now available with mounting bases of Bakelite, Screw or Shake-Proof nut, etc. BO and BJ Relays meet the individual requirements for tanks, planes, ships, etc.



Models BO (left) and BJ (right) Power Relays manufactured by the Allied Control Corp.

The design and construction of Allied Models BO and BJ Power Relays include easily accessible terminal connections and a semi-balanced armature to withstand vibratory motions with minimum coil power.

Stuart Oil Products
Commandos of Industry!
Stuart's
Thred Kut
HEAVY DUTY CUTTING OIL
Recommended by America's leading machine tool builders
Stuart's
CODOL
LIQUID GRINDING COMPOUND
Meets every test for the ideal Modern Grinding Compound
Stuart's
"SUPER-KOOL"
AMERICA'S FIRST TRANSPARENT SULPHURIZED CUTTING AND DRAWING OIL
Stuart's
SOLVOL
LIQUID CUTTING COMPOUND
For carbide tools and where an "aquamix" solution is recommended
STUART OILS have led the attack on tough metal working problems for many years. Take advantage of the experience behind them and, without allowing superficialities to interfere, study your cutting fluid applications with the help of Stuart Oil Engineering Service.
Stuart Oil
Engineering
Goes with every Barrel
For All Cutting Fluid Problems
D. A. STUART OIL CO.
Chicago, U.S.A. • LIMITED • Est. 1865
Warehouses in All Principal Metal Working Centers

A Rubber Substitute

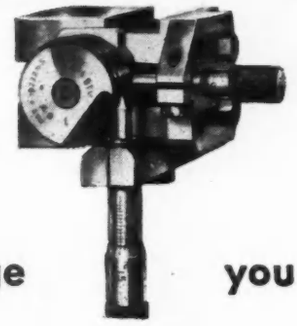
The Detroit Gasket and Manufacturing Co., Detroit, Mich., has developed a new rubber substitute suitable for the manufacture of braided rubber hose, packing and molded goods. During the past several months, many companies which make rubber goods or use rubber in their products, have been searching for a satisfactory replacement, and many discoveries have been brought to light. The laboratory technicians of the Detroit Gasket Co. have tested quantities of such materials and conducted hundreds of experiments of their own. Six months of testing, checking and actual making of "rubber" items have revealed a compound that measures up to "rubber" standards for hose, packing and molded goods with very few exceptions.

The sources of supply for this new material can make available 2,000,000 lb a month, and this figure may be increased with the greater interest of the Nation's manufacturers. Samples of garden hose, goggles, tubing and various extruded articles reveal rubber-like characteristics that suggest a virtually limitless field for the use of this new synthetic.

USL Battery Corp. Changes Name

The USL Battery Corporation, Niagara Falls, N. Y., has changed its name to the Auto-Lite Battery Corporation. Auto-Lite Battery is a subsidiary of Electric Auto-Lite Company, Toledo, Ohio. For several years batteries manufactured by USL have carried the trade name Auto-Lite.

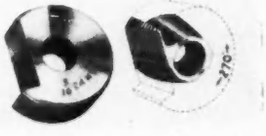
NAMCO *Double-Duty* AUTOMATIC HEADS

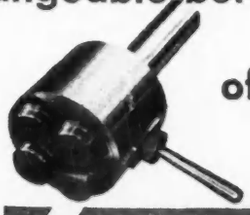


AVOID DOWN-TIME AND SCRAP LOSS—

When you grind circular hollow mills (or circular chasers) you check them with this micrometer gage you check to exact cutting edge dimensions, you know in advance of use that all four cutting edges are uniform and will produce tolerances identical with those before grinding.

Many users of Namco heads on war production schedules carry extra sets of hollow mills for the job, grind them in the tool room in advance—then make the change on the job in 2 MINUTES.

WHAT ABOUT COST? You grind and regrind circular hollow mills or chasers  to a full 270° of their circumference. This means 20 to 30 *times* longer life, which pays many times over for the difference in first cost.

THEN TOO—Circular hollow mills, like circular chasers are interchangeable between revolving and non-revolving heads  of like capacities. *Ask for D-42 Catalog.*

THE NATIONAL ACME CO.

170 EAST 131ST STREET • CLEVELAND, OHIO

ACME-GRIDLEY 4-6 AND 8 SPINDLE BAR AND CHUCKING-AUTOMATICS • SINGLE SPINDLE AUTOMATICS • AUTOMATIC THREADING DIES AND TAPS • SCREW MACHINE PRODUCTS • THE CHRONOLOG • LIMIT-SWITCHES • SOLENOIDS • POSITIVE CENTRIFUGE • CONTRACT MANUFACTURING

Fuels and Lubricants Discussed at Tulsa

(*Continued from page* 32)

Considerable difficulties are involved in obtaining a true photographic image of a cylindrical surface, and in an attempt to eliminate these, a piston-photographing machine was developed that gives an image of the entire piston surface developed in a plane, with practically no distortion. This device is based on the principle that the piston, when rolling on a circle, successively presents all points of its circumference at the same distance from the center of the circle. This principle is embodied in a mechanism that photographs only the portions of the piston in contact with the circle and takes a continuous exposure while the piston is being rolled along at constant speed. Fig. 2 is a schematic drawing of the device.

As the piston rolls along the generating arc, only that portion of its surface is exposed which is within ⅛ in. of the point of contact. This is accomplished by photographing through a slot ¼ in. wide, which moves with the piston and is in line with the point of contact and the camera lens. A slit ¼-in. wide does not introduce an appreciable error in the image. Points off the surface, such as the bottom of a ring groove, never become stationary during the exposure, and hence give a blurred image. The speed of motion of the piston along the generating circle is adjusted in the initial design to provide a normal exposure for the light source, lens opening, and film used. In an apparatus illustrated in the paper the speed was such as to ensure a 5-second exposure of any point. The device was designed to have as great a range of application as possible, and will take pistons ranging from 2⅝ to 6⅛-in. diameter.

An important study in the case of large aircraft pistons concerns the amount and type of deposit in the ring grooves. To obtain a sharp image of the ring-groove bottom, a second turntable is provided which has a diameter equal to that at the bottom of the ring groove. When the piston skirt is to be photographed, one turntable is used, and when the ring-groove bottom is to be photographed, the other turntable is used and is offset on the driving arm by the decrease in the turntable radius, so as to use the same generating circle.

Laboratory Oil Bench Tests

SOME work done under the program of the Bench-Test Sub-Committee of the Cooperative Lubricants Research Committee of the Cooperative Research Council was reported on by C. W. Georgi, technical director of the Quaker State Refining Corp., who is chairman of the sub-committee. The work referred to relates to the correlation of laboratory oil bench tests with full-scale engine tests, and was carried out by 20 cooperating laboratories. Six different oils were used in these tests, ranging from oils of moderately-low to quite high viscosity index, and from oils containing no additives to those containing both inhibitor and detergent addition agents. Full-scale engine tests were made on Chevrolet engines and covered oil stability, engine cleanliness and bearing corrosion. The detergency of these same oils was estimated from the lacquer formation on pistons of single-cylinder Diesel engines in 480-hour test runs and from other available data.

Underwood tests also were run on the six reference oils, but under different conditions by the different cooperating laboratories. In applying this test, some laboratories added small amounts of iron oxide (Fe_2O_3) as naphthenate to the oil, in which it acts as a catalyst, accelerating oxidation, while others used no catalyst. There were differences also with respect to the temperature at which the test was run, and the type of bearing used (in determining bearing corrosion).

One laboratory, which ran Underwood tests with successively increased

. . . Draw on Western's 42 Years' Experience in Fabricating Felt to Closest Specifications

GROMMETS
Channels
Washers
Gaskets
Pads
Anti-Squeak Strips
Lubrication Wicks
Insulation
Weatherstrips

● For more than four decades, Western Felt has specialized in the manufacture of felt. As a result of that experience, processes have been developed which permit the production of felt to surprisingly close tolerances. Methods of manufacturing *FELT* grommets have been perfected and this important development is now offered to relieve the critical rubber situation. The company's engineers are fully qualified to work with *your* design and product engineers on any problem involving the use of felt grommets. Use their services—and the modern manufacturing facilities of the largest independent manufacturer—

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Manufacturers and Cutters of Wool, Jute, and Hair Felts • Processors of Synthetic Rubber and Plastics • Sheets • Extrusions • Molded Parts

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WESTERN FELTS
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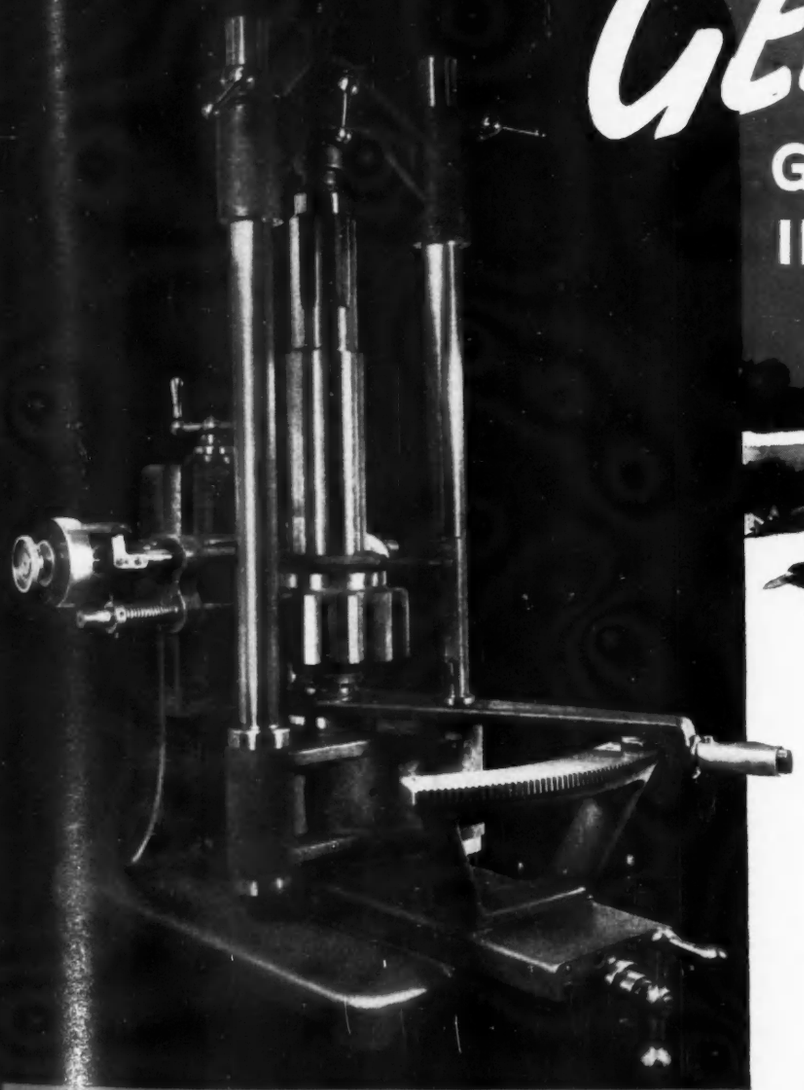
SYNTHETIC PRODUCTS

Check Gear Tooth Curves *with* GEARGRIND

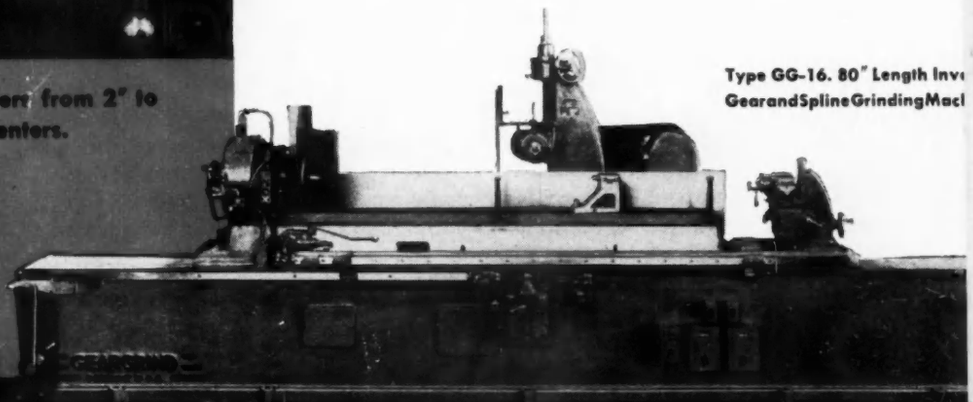
GEAR TOOTH INDICATORS



GEARGRIND Gear Tooth Curve Indicators have been designed to indicate and plot tooth curves *accurately*. They are manufactured to handle gear diameters of from 2″ to 18″. They will indicate and plot the tooth forms of spur, bevel and helical gears, rotary cutters and hobs. Gears and gear cutters are indicated direct. Rotary cutters and hobs are checked from soft gear blanks cut by them. Indicators and their operation are described fully in our catalog. Write for your copy.

Type M1-6. For gears with diameters from 2″ to 9″, on arbors up to 24″ between centers.

GEARGRIND Machines are available for the formed wheel grinding of internal and external gears, internal and external involute splines, straight splines, serrations and racks.



Type GG-16. 80″ Length Inv
GearandSplineGrindingMac

The GEAR GRINDING MACHINE COMPANY
DETROIT, MICH. U.S.A.

proportions of iron oxide as catalyst, obtained results which suggested that oils fall into four different types with respect to stability, as follows:

1. Oils which deteriorate rapidly both as to sludge formation and acid formation.
2. Oils which deteriorate with respect to sludge formation but which still retain resistance to acid formation and corrosiveness.
3. Oils which deteriorate with respect to acid formation and bearing corrosion but which still resist oxidation of the sludge-forming type.
4. Oils which are highly stable and resist all forms of oxidation, even under severe oxidizing conditions.

It was found that the results of the Underwood test correlate best with tests on the full-scale Chevrolet engine if the former is run under the following conditions: 325 F, 10 hrs, oil sample of 1500 cu cm, 0.01 per cent Fe_2O_3 as naphthenate, 2 by 10-in. copper baffle, one cadmium bearing and 10 psi oil pressure. Optional conditions include one copper-lead bearing, 5-hr test and the cleaning method.

Bench tests of lubricating oils usually are made on single-cylinder Lauson engines, and two different procedures are used, viz., the oil-stability or varnish procedure, involving high crankcase-oil temperatures, of the order of 280 F, and moderate coolant temperatures, of the order of 180 F; and the detergency or ring-sticking procedure, involving a moderate crankcase-oil temperature, of the order of 225 F, and a very high coolant temperature, of the order of 340 F to 400 F. The following conclusions were drawn from results obtained with the Lauson engine by the different cooperating laboratories:

Lauson Test Procedures

	A	B	C
Oil Temp., deg. F.....	280	225	225
Coolant Temp., deg. F.....	180 to 200	345 to 350	400
Test Time, hrs.	100 to 120	100 to 120	24 to 48
Engine speed, rpm.	1600 to 1800	1600 to 1800	1600 to 1800
Load, hp. ..	1.3 to 1.6	1.3 to 1.6	1.3 to 1.6

The Lauson engine is a remarkably-versatile oil-testing device, and with properly-selected operating conditions apparently can be made to rate oils as to their stability, bearing-corrosion, detergency and ring-sticking properties in agreement with full-scale engine tests. The duration of the test, the oil temperature, and the coolant temperature are the most important variables. Engine speed does not seem to be critical over a considerable range. Load also does not seem to be critical in oil evaluation, although laboratories which reported loads of the order of 1.5 hp seemed to have had little trouble in the way of mechanical failure of engine parts, whereas others which operated at full load reported difficulties with connecting-rod and crankshaft breakage, and in some instances had resorted to extensive changes in the engine to prevent such troubles.

The table herewith shows sets of Lauson operating conditions for three different investigations, viz., A, evaluating oil stability and bearing-corrosion tendencies; B, evaluating detergency and bearing corrosion, and C, for an accelerated detergency and ring-sticking procedure. These sets of test conditions represent the general average of the various procedures used by the cooperating laboratories which reported the most consistent results on the six reference oils.

Transparent Plastic Models

(*Continued from page* 44)

units from the present viewpoint, and cannot be taken as an indication of the full possibilities of the medium. For instruction, examples of complete power units have been made, not wholly but largely in transparent material. Transparent crankshaft and big-end assemblies have been supplied to check oil distribution at various speeds and pressures, and, as will be seen from one of the illustrations, the range of components already produced includes a built-up crank with roller bearing connecting rod, all in transparent plastic.

TANKS FOR PROTECTION

PROTECTION FOR TANKS

Every Spray Booth shipped from our doors helps the war effort. It plays an important part in the process of painting army tanks, aircraft parts, and in some instances, the complete plane.

Hydro-Whirl Spray Booths are doing such a praiseworthy job because their unique design and construction makes possible a recovery of an unusually high percentage of paint—an accomplishment much desired by the War Production Board. As you know, the reclamation of wasted spray paint is emphatically urged by the conservation Division of W. P. B.

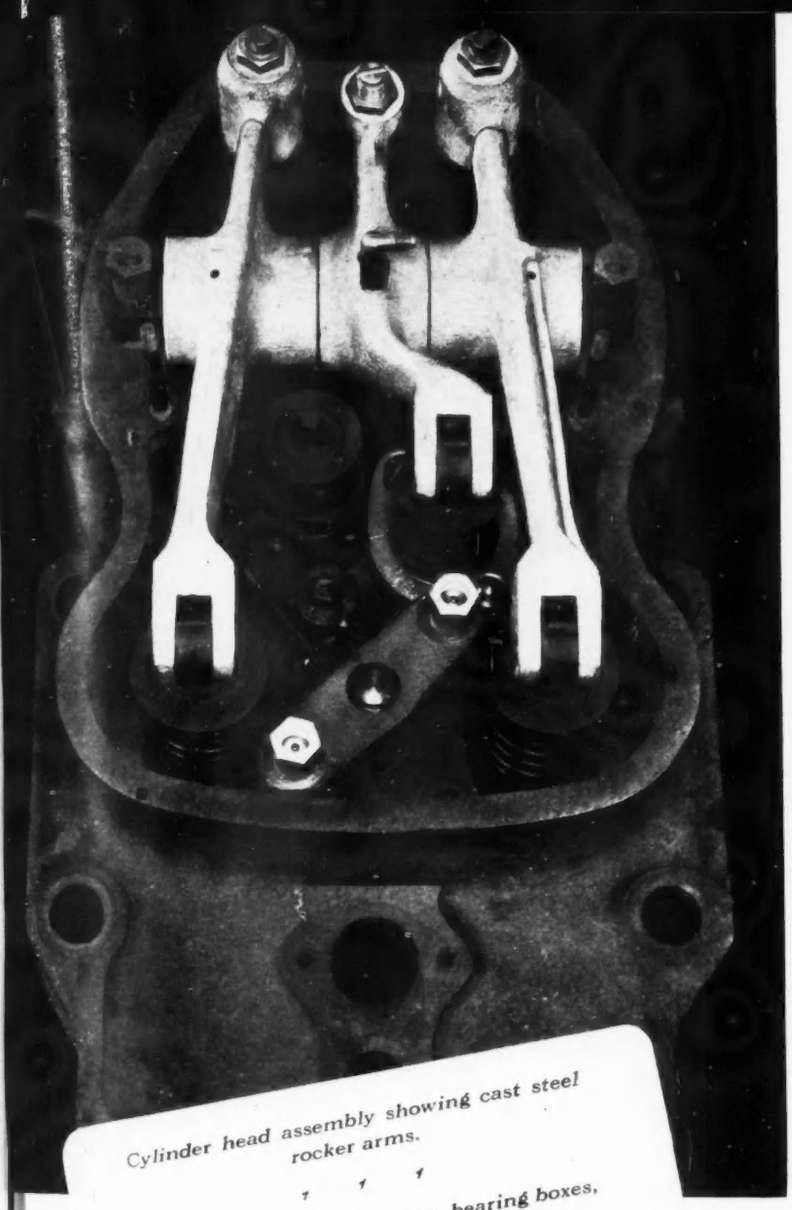
In addition to the salvaging of essential chemicals, Hydro-Whirl has the advantage of also reducing maintenance costs, as wet paint fumes are not drawn through the exhaust fan and discharge ducts. The necessity for cleaning beyond the booth is thus eliminated. Moreover, since the cleaned air may be returned to the building, heating costs are materially reduced.

Industrial Sheet Metal Works

Manufacturers of Hydro-Whirl Dust Collectors and Spray Booths, Ovens, and Parts Washers. Completely Engineered and Installed.

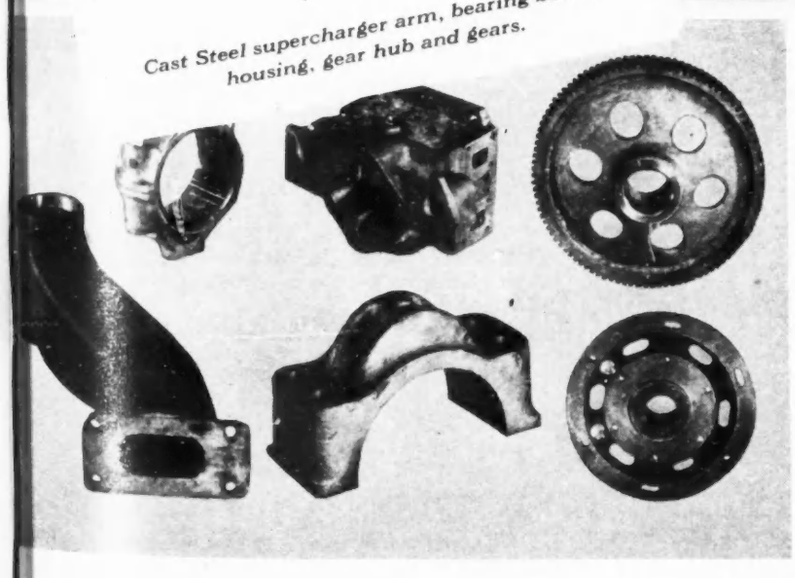
634 E. FOREST AVE., DETROIT, MICH.

370 LEXINGTON AVE NEW YORK OFFICE



Cylinder head assembly showing cast steel rocker arms.

Cast Steel supercharger arm, bearing boxes, housing, gear hub and gears.



Diesel Power

DEPENDS ON

CAST STEEL

Vital parts of the Diesel engines that drive trains and ships and trucks are steel castings. These rarely-seen arms and gears and valves and housings deliver unfailing production of power, maintaining their precision fit, and their resistance to high pressure, wear, heat, vibration and fatigue.

Wherever tough conditions must be met by metals, steel castings are giving faultless performance.

From small parts precisely shaped to close tolerances, to large structural members weighing tons, castings are the most economical means of securing the many desirable properties of steel.

They help to speed up manufacture—to save time in finishing and assembly. Often they are complicated shapes that could not be economically produced by any other method. They afford almost infinite variety of mechanical properties readily obtainable by using different heat treatments and alloy additions. They may be perfectly welded in composite structures.

If you'd like to have your own products analyzed, to see where steel castings can make them better or less costly to build, consult your own foundryman, or write to Steel Founders' Society, 920 Midland Bldg., Cleveland. No obligation of course.

MODERNIZE AND IMPROVE YOUR PRODUCT WITH

STEEL CASTINGS

Ford War Plant Facilitates Straight-Line Production

(*Continued from page* 24)

ing, using large vertical Colonial broaches for large bores, small machines for tiny bores. In each case, the machines are of pull-down type, a procedure found to work best in Ford plants. On the large splines, the broaching is done in two passes.

Milling operations on all gears are handled on a battery of Cincinnati and Kearney & Trecker machines of various types and sizes. Prominent in the line-up of equipment are many bench type drills consisting of Delta drills mounted in gangs of four to eight on special benches.

The spline form on the impeller shaft and on certain other parts is of such character as to make it necessary to rough-shape on the Fellows gear shaper, then finish to form in some other way. Unique solution of this problem is the conversion of a Fitchburg gear grinder to serve as a spline shaper.

In the gear grinding department, Heald internal grinders are employed for all manner of bores, using Garrison chucks for holding bevel gears. Landis and Cincinnati cylindrical grinders are used for external surfaces. Soluble oil compound is used for grinding and gear grinding operations. After grinding, the gears are given a dip in a deep tank containing oil at 350 deg F to relieve surface strains, a procedure said to eliminate grinding checks.

As might be anticipated, the largest department in the plant is the one devoted to the machining of the crankshaft, easily the most complex part from the standpoint of metal cutting, involving some 500 detail operations. The shaft is received as a single forging, then is cut-off into three sections each of which is followed through heat treatment by a test coupon cut from the original forging. Most of the initial rough turning operations are done on Wickes crankshaft lathes. Cheek contour is form-milled on three-spindle Cincinnati Hydro-Tels. Rough and finish grinding is handled on a battery of Landis crankshaft grinders.

After heat treatment, the cheek contour is corrected on Cincinnati Hydro-Tels. Internal and external splines are cut on Fellows gear shapers, an exceedingly delicate operation what with index being held to several thousandths. On this operation, the work station is flooded with a mixture containing Houghton base cutting oil.

Tolerances on the crankshaft are so fine and alignment of its sections so critical that it is necessary to employ selective assembly and matching of individual sections. One operation depending upon accurate preliminary assembly is that of grinding the bores through the entire shaft. This is done on a large Heald internal grinder, the resulting bores being checked with a Sheffield Precisionnair gage.

An unusual piece of equipment is the horizontal type Fellows gear shaper designed for cutting the internal spline in the end of the crankshaft. External splines are cut on Sundstrand Hydro-Screw millers, ground on Fitchburg spline grinders. All external threads are finish-ground on a Jones & Lamson thread grinder.

Following the various machining and grinding operations, the assembly is lapped in a Schraner lapping machine, disassembled, Magnafluxed in individual sections, then re-assembled and balanced on a Tinius Olsen balancing machine. Then the pins and bearings are re-lapped on a Schraner lap as a 100 per cent operation.

Engine assembly and testing are handled on the first floor of the engine building. The job has been skillfully sub-divided into a large number of sub assemblies which are made up on benches. The final assembly then is integrated on large assembly stands which are moved along on rails from station to station picking up the sub assemblies enroute. Before assembled

● Since Triad chemicals were first introduced, they have been constantly improved. Today, in spite of production demands . . . and the fact that Triad solvents and Triad alkali cleaning compounds are unsurpassed for their specific purposes . . . laboratory work and chemical research continues.

Future changes in various grades of Triad may be minor, or they may be radical. However, you may be sure that any possible improvements which can be useful to your War Production metal cleaning operations will be made.

● *Vapor-slush Detrex Degreaser arranged for steam heating and is equipped with vapor level control and operating platform.*

● *Three-stage spray washer with mesh belt conveyor. Incorporates hot alkali sprays, hot water rinse and a hot air blast blow-off.*

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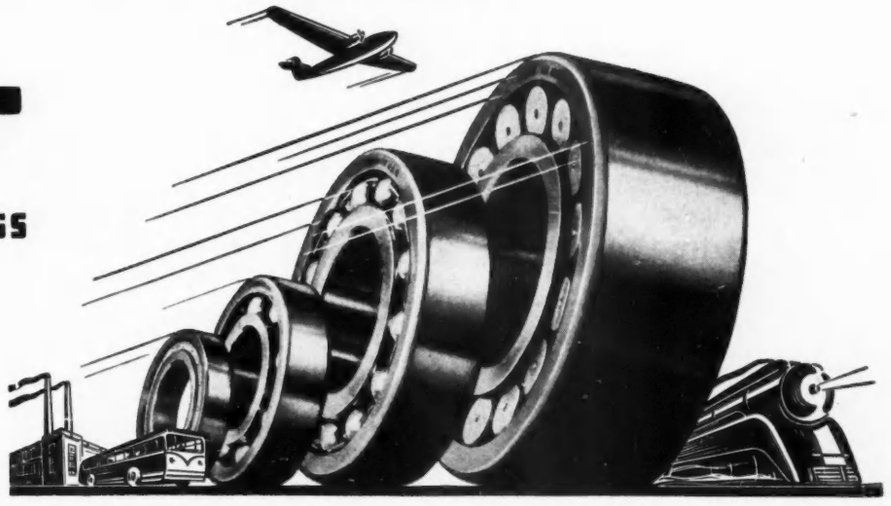

engines go to the green run, each engine is mounted on a special electric motor stand and turned over for a superficial check to guard against oil leaks.

While on the subject of the green assembly, it is of interest to find that the piston and ring assembly is fitted to a mating cylinder barrel by lapping-in on special Barnes Drill Co. lapping machines, then routed in matched sets to the assembly line.

When the tested engines come in to the green test cells, they are installed on specially-designed test stands in the test cell gallery, ready to go into the test cell. One feature of these test stands is the provision of a group of plug-in connections to accommodate various service connections in the test cell, thus greatly facilitating the task of making ready for the test run.

Following the green run, the engines are completely torn down, and the component parts thoroughly washed in a large Detroit Rex kerosene washing machine. The parts are laid out on portable stands—two required per engine—and subjected to searching inspection by civilian and Army inspectors. When they have passed muster the engines are re-assembled, made ready for the final test run.

All of the test cells, control rooms, stacks, and the propeller test house are given full protection against the hazards of fire or explosion by the well known Cardox fire extinguishment system. The Cardox equipment at Ford consists of two six-ton carbon dioxide storage systems, one of the largest installations in the industry. Test cell protection is designed for push-button control with further provision for automatic control through the action of thermostats set at 450 deg F, when no operators are present. Control rooms for the test cells and the generator rooms are protected in a similar manner except that the thermostats are set for 165 deg F.

Adequate fire protection is assured by total flooding, the system being so designed that the carbon dioxide requirements for a fire in any of the cells leaves ample reserve capacity for four to eight additional fires, without immediate recharging of the storage tanks.

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Aircraft Seat of Non-Strategic Materials

By combining several non-strategic materials, the Harvill Corporation, Los Angeles, Cal., has developed a seat for training, pursuit and bombing aircraft, called the Plasti-Seat, which is said to be a more efficient structure than one made of any one material. Plastic impregnated fabric is used with special wood structures to produce a seat which is light in weight, yet exceeding all strength requirements. Two basic types of seats have been developed, the first

Plasti-Seat made by the Harvill Corporation.

meeting specification AN-7505 for pursuit and training planes, the other meeting specification AN-S-1 for long range bomber seats.

Several types are being made, taking the shoulder-harness loads on the seat backs alone where installations require such deviations from the standard. No heat or pressure is required in fabrication, which makes repairs in the field easy and practical.